AMERICAN CYCLOPEDIA

OF

PRACTICAL MEDICINE AND SURGERY

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THE AMERICAN CYCLOPEDIA OF PRACTICAL MEDICINE AND SURGERY;

A DIGEST OF MEDICAL LITERATURE.

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PRACTICAL MEDICINE AND SURGERY.

A. *In composition.* This letter, the α privative in Greek, and *a*, particle, in Latin, signifies a negation—the absence, want, or privation of a thing: thus, *aphonia*, without voice, from α priv. and φωνη, the voice. Before a vowel, and also before certain consonants, *a* is changed into *ab*, or *an:* thus *abirritation*, from *a* priv. and *irritatio*, irritation; *abnormal*, from *a* priv. and *norma*, a rule; *anodyne*, from α priv. and ὀδυνη, pain. The *a* particle is often confounded with the preposition *a*, in Latin. The latter signifies from, and in composition is changed before a vowel and certain consonants, into *ab*, or *abs;* as abductors, from *ab*, from, and *ducere*, to draw, &c.

ABAPTISTON, or *Abaptista.* (From α priv. and βαπτιζειν, to plunge.) This term was employed by Galen and some of the old surgeons, to designate the crown of the trephine, which was formerly furnished with a projecting rim, and subsequently made of a conical form, to prevent its penetrating too deeply, and injuring the dura mater and brain. See TREPHINE.

ABBREVIATION, or *Abbreviature*, from the Latin *abbreviatio*, is the contraction of a word or passage, made by dropping some of the letters, or by substituting certain marks or characters in their place. Abbreviations are used principally either for celerity or secrecy; and were probably resorted to for both purposes by the older physicians, who made copious use of them. Numerous errors having been found to be occasioned by their employment, they are now much less used than formerly. The following is, we believe, a tolerably complete list of the abbreviations in use at the present day, in medicine and pharmacy.

A. or *ā.* or *āā.* *Ana*, of each.

Ab. *Abrade*, scrape.

Abs. febr. *Absente febre*, in the absence of fever.

Add. *Adde*, or *addatur*, add, or let be added; *addendus*, to be added; *addendo*, by adding.

Ad def. animi. *Ad defectionem animi*, to fainting.

Ad 2 vic. *Ad duas vices*, at twice taking.

Ad 3tiam vicem. *Ad tertiam vicem*, for three times.

Ad gr. acid. *Ad gratam aciditatem*, to an agreeable acidity.

Adj. *Adjacens*, adjacent.

Ad lib. *Ad libitum*, at pleasure.

Admov. *Admove*, or *admoveatur*, or *admoveantur*, apply, or let be applied.

Adst. febr. *Adstante febre*, when the fever is present.

Adv. *Adversus*, against.

Aggred. febr. *Aggrediente febre*, whilst the fever is coming on.

Altern. hor. *Alternis horis*, every other hour.

Alvo adst. *Alvo adstricta*, when costive.

Aq. *Aqua*, water.

Aq. bull. *Aqua bulliens*, boiling water.

Aq. com. *Aqua communis*, common water.

Aq. dist. *Aqua distillata*, distilled water.

Aq. ferv. *Aqua fervens*, hot water.

Aq. font. *Aqua fontana*, spring water.

Aq. mar. *Aqua marina*, sea water.

Aq. pluv. *Aqua pluvialis*, rain water.

Aq. pur. *Aqua pura*, pure water.

B. A. *Balneum arenæ*, a sand-bath.

Bals. *Balsamum*, balsam.

Bib. *Bibe*, drink.

Bis ind. *Bis in dies*, twice a day.

B. M. *Balneum Mariæ*, sea-bath.

Bol. *Bolus*, a bolus.

Bull. *Bulliat*, or *bulliant*, let boil.

But. *Butyrum*, butter.

B. V. *Balneum vaporis*, a vapor-bath.

Cœrul. *Cœruleus*, blue.

Cap. *Capiat*, let the patient take.

C. C. *Cornu cervi*, hartshorn. *Cucurbitula cruenta*, a cupping-glass.

C. C. U. *Cornu cervi ustum*, burnt hartshorn.

Chart. Chartula, or *chartulæ*, a small paper or papers.
C. M. Cras mane, to-morrow morning.
C. N. Cras nocte, to-morrow night.
Cochl. Cochleare, a spoonful (half an ounce.)
Cochl. amp. Cochleare amplum, a large spoonful.
Cochl. infant. Cochleare infantis, a child's spoonful.
Cochl. mag. Cochleare magnum, a large spoonful.
Cochl. med. Cochleare medium, a dessert spoonful.
Cochl. mod. Cochleare modicum, a dessert spoonful.
Cochl. parv. Cochleare parvum, a small spoonful.
Col. Cola, strain; *colatus*, strained; *colaturæ*, of or to the strained liquor.
Colet. Coletur, let it be strained.
Colent. Colentur, let them be strained.
Collyr. Collyrium, an eye-water.
Comp. Compositus, compounded.
Conf. Confectio, confection.
Cong. Congius, a gallon.
Cont. Contunde, contuse, contusum, contused.
Cons. Conserva, conserve.
Contin. Continuatur, let it be continued.
Cont. rem. Continuantur remedia, let the remedies be continued.
Coq. Coque, boil. *Coquantur*, let them be boiled.
Coq. ad. med. consumpt. Coque ad medietatis consumptionem, boil till half is consumed.
Coq. S. A. Coque secundum artem, boil according to art.
Coq. in S. Q. Coque in sufficiente quantitate aquæ, boil in a sufficient quantity of water.
Cort. Cortex, the bark.
Crast. Crastinus, for to-morrow.
Cuj. Cujus, of which.
Cujusl. Cujuslibet, of any.
C. V. Cras vespere, to-morrow evening.
Cyath. Cyathus, a cup (about four ounces).
Cyath. theæ. Cyatho theæ, in a cup of tea.
D. Dosis, a dose.
Deaur. pil. Deaurentur pilulæ, let the pills be gilt.
Deb. spiss. Debita spissitudo, a proper consistence.
Dec. Decanta, decant.
Decoct. Decoctum, decoction.
Decub. Decubitus, lying down.
De d. in d. De die in diem, from day to day.
Dej. alvi. Dejectiones alvi, stools.
Dep. Depuratus, purified.
Det. Detur, let it be given.
D. et S. Detur et signetur, let it be given and labelled.
Dieb. alt. Diebus alternis, every other day.
Dieb. tert. Diebus tertiis, every third day.
Dig. Digere, or *digeratur*, digest, or let be digested.
Dil. Dilutus, diluted.
Diluc. Diluculo, at break of day.
Dim. Dimidium, one half.
Dir. prop. Directione propria, with a proper direction.
Dist. Distilla, or *distillata*, distil, or distilled.
Div. Divide, divide.
Donec alv. bis dej. Donec alvus bis dejiciat, until two stools are obtained.
Donec alv. sol. fuer. Donec alvus soluta fuerit, until a loose stool is obtained.
Ed. Edulcora, sweeten.
Ejusd. Ejusdem, of the same.
Elect. Electuarium, electuary.
Enem. Enema, a clyster. *Enemata*, clysters.
Exhib. Exhibe, give.
Extr. Extractum, an extract.
Ext. sup. alut. Extende super alutum, spread upon leather.
F. Fac. make; *fiat, fiant*, let be made.
Feb. dur. Febre durante, during the fever.
Fem. intern. Femoris internis, to the inner part of the thighs.
F. H. Fiat haustus, let a draught be made.
Filt. Filtra, filter.
Fist. arm. Fistula armata, a clyster-pipe and bladder fitted for use.
Fl. Flores, flowers.
Fl. Fluidus, liquid.
F. L. A. Fiat lege artis, let it be made by the rules of art.
F. M., or *F. mist. Fiat mistura*, let a mixture be made.
Fol. Folia, flowers.
F. pil. Fac pilulas, make into pills.
Fruct. Fructus, fruit.
Frust, Frustillatim, in small pieces.
F. S. A. Fiat secundum artem, let it be made according to the rules of art.
Garg. Gargarysma, a gargle.
Gel. quav. Gelatina quavis, in any kind of jelly.
G. G. G. Gummi guttæ Gambæ, gamboge.
Gr. Granum, a grain; *grana*, grains.
Gum. Gummi, gum.
Gutt. or *gtt. Gutta*, a drop; *guttæ*, drops.
Gutt. quibusd. Guttis quibusdam, with a few drops.
Guttat. Guttatim, by drops.
Har. pil. sum. iij. Harum pilularum sumantur tres, let three of these pills be taken.
Haust. Haustus, a draught.

Hb. or *herb.* *Herba*, the plant.
H. D. or *Hor. decub.* *Hora decubitus*, at bed-time.
Hor. un. spatio. *Horæ unius spatio*, at the expiration of an hour.
Hor. interm. *Horis intermediis*, at intermediate hours.
Hor. 11*ma. mat.* *Hora undecima matutina*, at eleven o'clock in the morning.
H. S. or *Hor. som.* *Hora somni*, just before going to sleep, or on retiring to rest.
Inc. *Incide*, cut.
Ind. *Indies*, daily.
Inf. *Infusum*, an infusion; *infunde*, infuse; *infundatur*, let it be infused; *infundantur*, let them be infused.
Inj. enem. *Injiciatur enema*, let a clyster be given.
In pulm. *In pulmento*, in gruel.
Jul. *Julepus*, a julep.
Lat. dol. *Lateri dolenti*, to the affected side.
Lim. *Limones*, lemons.
Liq. *Liquor*, liquor.
M. *Misce*, mix; *mensura*, by measure; *manipulus*, a handful; *minimum*, a minim.
Mac. *Macera*, macerate.
Man. *Manipulus*, a handful.
Mane pr. *Mane primo*, very early in the morning.
Mass. *Massa*, a mass.
Mic. pan. *Mica panis*, crumb of bread.
Mist. *Mistura*, a mixture.
Mitt. *Mitte*, send; *mittatur*, or *mittantur*, let there be sent.
Mitt. sang. ad ℥ *xij saltem*, take at least 12 oz. of blood.
Mod. præscrpt. *Modo præscripto*, in the manner directed.
Mor. sol. *More solito*, in the usual manner.
Muc. *Mucilago*, mucilage.
No. *Numero*, in number.
N. M. *Nux moschata*, nutmeg.
Ol. *Oleum*, oil.
Ol. lini s. i. *Oleum lini sine igne*, cold drawn linseed oil.
O. M., or *Omn. man.* *Omni mane*, every morning.
Omn. bih. *Omni bihorio*, every two hours.
Omn. hor. *Omni hora*, every hour.
O. N., or *Omn. noct.* *Omni nocte*, every night.
O. O. O. *Oleum olivæ optimum*, best olive oil.
Omn. quadr. hor. *Omni quadrante horæ*, every quarter of an hour.
Ov. *Ovum*, an egg.
Ox. *Oxymel.*
P. *Pondere*, by weight.
Part. æqual. *Partes æquales*, equal parts.
Part. vic. *Partibus vicibus*, to be given in divided doses.
Per. op. emet. *Peracta operatione emetici*, when the operation of the emetic is finished.
Ph. D. *Pharmacopœia Dublinensis*, Dublin Pharmacopœia.
Ph. E. *Pharmacopœia Edinensis*, Edinburgh Pharmacopœia.
Ph. L. *Pharmacopœia Londinensis*, London Pharmacopœia.
Ph. U. S. Pharmacopœia of the United States.
Pil. *Pilula*, a pill; *pilulæ*, pills.
Post. sing. sed. liq. *Post singulas sedes liquidas*, after every loose stool.
Pot. *Potio*, a potion.
Ppt. *Preparatus*, prepared.
P. rat. æt. *Pro ratione ætatis*, according to the age (of the patient).
P. r. n. *Pro re nata*, as circumstances may require.
Pug. *Pugillus*, the quantity of any substance which may be taken between a finger and thumb, the eighth part of a handful.
Pulp. *Pulpa*, the pulp.
Pulv. *Pulvis*, a powder.
Q. Æ. *Quantitas æqualis*, equal part.
Q. p. *Quantum placet*, as much as you please.
Q. s. *Quantum sufficit*, or *quantum satis*, as much as is sufficient.
Quor. *Quorum*, of which.
Q. V. *Quantum vis*, as much as you will.
℞. *Recipe*, take. Ancient authors used the sign ♃, the old heathen invocation to Jupiter, soliciting his blessing upon the formula.
Rad. *Radix*, the root.
Ras. *Rasura*, shavings.
Rect. *Rectificatus*, rectified.
Red. in pulv. *Redigatur in pulverem*, let it be reduced to powder.
Reg. umb. *Regio umbilici*, the umbilical region.
Repet. *Repetatur*, or *repetantur*, let it or them be repeated.
S. *Signa*, write.
S. A. *Secundum artem*, according to art.
Sac. or *Sacch.* *Saccharum*, sugar.
Sal. Salt.
Sem. *Semen*, seed.
Semih. *Semihora.*
Serv. *Serva*, keep, or preserve.
Sesquih. *Sesquihora*, an hour and a half.
Sesunc. *Sesuncia*, an ounce and a half.
Signat. *Signatura*, a label.
Sign. *Signa*, label it.
Si n. val. *Si non valeat*, if it does not answer.
Si op. sit. *Si opus sit*, if there be occasion.
Si vir. perm. *Si vires permittant*, if the strength will bear.

S. N. Secundum naturam, according to nature.
Solv. Solve, dissolve.
Spt. Spiritus, spirit.
Sq. Squama, scale.
S. S. S. Stratum super stratum, layer upon layer.
St. Stet, let it stand; *stent*, let them stand.
Sub. fin. coct. Sub finem coctionis, when the boiling is nearly finished.
Succ. Succus, juice.
Sum. Sumat, let the patient take.
Sumend. Sumendum, to be taken.
Sum. tal. Sumat talem, let the patient take one like this.
S. V. Spiritus vinosus, ardent spirit.
S. V. R. Spiritus vini rectificatus, spirit of wine.
S. V. T. Spiritus vinosus tenuis, diluted spirit, or alcohol and water in equal parts.
Syr. Syrupus, syrup.
Temp. dext. Tempori dextro, to the right temple; *tempori sinistro*, to the left temple.
Tinct. Tinctura, a tincture.
T. O. Tinctura opii, tincture of opium.
Tr. Tinctura, a tincture.
Trit. Tritura, triturate.
Ult. prescr. Ultimo prescriptus, the last ordered.
Vesp. Vespere, in the evening.
Vin. Vinum, wine.
V. O. or *Vit. ov. Vitellus ovi*, yolk of an egg.
V. O. S. Vitello ovi solutus, dissolved in the yolk of an egg.
Vom. urg. Vomitione urgente, the vomiting being urgent.

Cal. Calix.
Corol. Corolla.
Ped. Peduncle.
Per. Pericarp.
Pet. Petiole.
Recep. Receptacle.
Stam. Stamen.
Stip. Stipule.
☼ signifies that the plant is an annual one.
♂ ——————— a biennial one.
♃ ——————— a perennial one.

WEIGHTS AND MEASURES.

Lib. or ℔. *Libra* or *Libræ*, a pound or pounds. When preceded by Arabic figures, Avoirdupois weight is meant; when succeeded by Roman numerals, Troy weight is intended.
O. Octarius, a wine pint.
Oz. An ounce avoirdupois.
℥. *Uncia*, or *Unciæ*, an ounce, or ounces, Troy.
f℥. *Fluiduncia*, a fluid ounce.
ʒ. *Drachma*, or *Drachmæ*, a drachm, or drachms.
fʒ. *Fluidrachma*, a fluid drachm.
℈. *Scrupulus*, or *Scrupuli*, a scruple, or scruples.
Gr. Granum, or *Grana*, a grain, or grains.
Min. or ♏. *Minimum*, a minim, the 60th part of a fluidrachm.
Ss. Semis, one half; as ʒss. half a drachm, ℈ss. half a scruple, &c.
j. one; *ij.* two; *iij.* three; *iv.* four, &c.

I. HAYS.

ABDOMEN, from *abdere*, to hide, or conceal. The appellation, abdomen (*cavum abdominis*), is applied to an irregular ovoid cavity, which terminates the inferior portion of the trunk of the body.

ART. I. ANATOMY OF THE ABDOMEN.

§ 1. *General Anatomical Description of the Abdomen.* The abdomen is by far the largest of all the splanchnic cavities, and is occupied by the most important organs of nutritive or vegetative life, as well as by a portion of those which are subservient to the secretion and excretion of urine, and the propagation of the species. In the living state, it is everywhere accurately filled by these organs, and its yielding parietes readily accommodate themselves to their various states of plenitude and distension, as well as to their opposite conditions of vacuity and collapse. There is, therefore, under no circumstances any vacuity within this extensive region of the body; and it only assumes the condition of a cavity, in the strict sense of the word, after the natural relations of the organs with its parietes and with each other, have been destroyed by the flaccidity of death, or after they have been removed by the dissector.

Examined in a general manner, the cavity of the abdomen presents two surfaces: one external, and the other internal, the configuration and arrangement of which vary according to the point at which they are examined.

The external surface of the abdomen presents an anterior, a posterior, and two lateral faces, and an upper and a lower extremity, which, however, as the cavity is rounded or ovoid, pass insensibly into each other, and are everywhere continuous.

1. *Parietes of the Abdomen.*—Their anterior face is for the most part convex throughout its whole extent, though it presents some irregularities occasioned by slight elevations and depressions. It is terminated above by the ensiform cartilage of the sternum; in the middle, and on each side, by the cartilages of the ribs as far back as a perpendicular line drawn from the middle of the margin of those bones, to the anterior superior spinous process of

the ilium. Laterally, it is bounded on each side by the same perpendicular line; and inferiorly by a line drawn from the anterior superior spine of the ilium to the symphisis pubis, which is marked by a deep depression called the fold of the groin, and which corresponds to the course of Poupart's ligament; and by the symphisis pubis upon the middle part of its inferior limits.

The upper portion of the anterior face of the abdominal parietes presents in the middle, and immediately below the extremity of the sternum, a considerable depression or concavity, corresponding to the situation called the *præcordia, scrobiculus cordis*, or epigastric depression. From this, a perpendicular depression, the depth of which varies in different subjects, descends to the symphisis pubis, where it is terminated by a slight prominence, surmounted with hairs, called the *mons veneris.* This furrow corresponds accurately to the median line of the body, and to the point at which the aponeurosis of the muscles of the abdomen interlace with each other, to form what is designated the *linea alba.* This line or furrow is surmounted, between the sternum and the pubis, by a small circular depression or cicatrix called the umbilicus. On each side of this perpendicular line there is a considerable prominence which runs parallel with it, the boldness of the outline of which is always in proportion to the development of the adipose tissue and the recti muscles, and which consequently, for the latter reason especially, is generally more conspicuous in a stout muscular male adult, than in those who are feeble or emaciated, or in females.

The lateral faces of the abdominal parietes are less extensive than the anterior. They comprise that portion situated between the inferior margin of the ribs, laterally, and the upper semicircular border of the ilium. Forwards they are limited on each side by the perpendicular line extended upwards from the anterior superior spinous process of the ilium to the border of the ribs, and posteriorly by a similar perpendicular line drawn from the posterior superior spinous process of the same bone to the ribs above. By this line, the lateral walls are separated from the posterior. This portion of the external face of the abdominal parietes is slightly concave from above downwards, and convex in its antero-posterior direction. Its dimensions not only vary in different individuals, but also in the same individual in the various acts and positions of the trunk of the body. When the body is inclined forwards or laterally, the ribs are brought much nearer to the border of the pelvis, and the vertical diameter is consequently very much diminished; while a flexure in the opposite direction, by separating the same parts from each other, produces the contrary effect.

The posterior, or lumbar portion, of the outer surface of the abdominal parietes is of limited extent, and comprises the space situated between the two vertical lines which mark the posterior boundary of the lateral regions on each side. It corresponds to the direction of the vertebral column, and presents, upon the median line, a deep perpendicular concavity, the centre of which is occupied by the spinous processes of the lumbar vertebræ. On each side of this, and parallel with it, are two considerable rounded prominences formed by the spinal muscles. Its extent and configuration are but slightly influenced by the different movements and attitudes of the body, in consequence of the limited mobility of the parts which enter into its formation.

The upper portion of the walls of the abdomen is formed by the diaphragm, a muscular partition between the abdominal and thoracic cavities. Attached posteriorly to the front and sides of the vertebra, anteriorly to the sternum, and laterally to the whole extent of the internal surface of the margins of the ribs, this muscle is so disposed as to present a considerable convexity towards the thorax, and a corresponding concavity towards the abdomen, which are greatly increased during each act of expiration, and diminished during every inspiration. The thoracic face of this muscle is covered anteriorly and laterally by the diaphragmatic portion of the pleura, which adheres intimately to its surface, and a considerable portion of it, besides, is attached to the pericardium, and has the heart reposing upon it.

The outer surface of the inferior portion of the walls of the abdomen is the most irregular and complicated in its arrangement. It is represented by the external configuration of the pelvis. Laterally, it corresponds to the dorsum of the ilium and the outer face of the ischium; posteriorly, to the posterior face of the sacrum and coccyx, which present a convexity backwards, along which are arranged the spinous processes; inferiorly, by the ano-perinæal region, perforated at its posterior part by the anus, and traversed in a direction from behind forwards by a medial prominence corresponding to the raphe of the perinæum, and anteriorly, inferiorly, and

somewhat laterally, by the symphisis pubis, and the rami of that bone and of the ischium. In consequence of this portion of the walls of the abdomen being formed by the strong bones of the pelvis, it is much firmer and less yielding than any of those which have been described. It has the two inferior extremities ingrafted upon its lateral surfaces, and as it has to sustain the entire weight of the trunk and upper extremities, it requires great solidity of construction to adapt it to this office.

The internal face of the walls of the abdomen may be divided into the same number of parts as the external, though at some points it exhibits an entire difference of conformation. The posterior wall is rendered convex and prominent by the projection of the bodies of the vertebræ, and the muscles which repose upon them on each side. It is bounded above by the pillars of the diaphragm, and below by the promontory of the sacrum. On each side, it is limited by the extremities of the transverse processes of the vertebræ, and the sacro-iliac symphisis. On each side of the spinal column, the upper part of this region exhibits a plane surface, formed by the quadratus lumborum muscle, and lower down, an elongated rounded prominence, ranging obliquely downwards, occasioned by the psoas muscle.

The internal face of the lower wall corresponds to the cavity of the pelvis, and represents a deep excavation, the axis of which intersects that of the upper portion of the abdomen at an obtuse angle. The upper part of this region is expanded laterally, so as to form two inclined concave surfaces, corresponding to the inner face of the ilium, which are denominated iliac fossæ. They are occupied by the iliacus internus muscle, and are bounded internally by the psoas as it advances downwards beneath Poupart's ligament. Lower down, the lateral face of this region corresponds to the inclined plane of the ischium, and the parts which fill up the sacro-sciatic notch, and extends from the brim of the pelvis, or the *linea ilio-pectinea*, to the *perinæum*. It exhibits a regular concave surface, the several openings and irregularities of the bones being filled up by muscles, ligaments, fascia, vessels, and nerves. The anterior portion of the lower face of the abdomen is of small extent, and is formed by the posterior concave surface of the symphisis pubis. The posterior is much more extensive, and comprises the entire space situated between the promontory of the sacrum and the coccyx. It exhibits a regular concavity throughout its whole extent, but is somewhat narrower below than above, and is bounded laterally by the sacro-iliac symphisis and the sacro-sciatic notch. The whole surface, being formed by the concave face of the sacrum, is solid and resistant. The inferior portion of the lower face of the abdomen is formed by the perinæum, and is comprised between the extremity of the coccyx, the tuberosity of the ischium, the rami of the same bone, and the arch of the pubis. Posteriorly, it is perforated by the anus as already stated, and anteriorly by the urethra, in the male, and the vagina in the female.

The superior wall of the abdomen is formed, as has been already explained, by the diaphragm, the concave face of which constitutes its internal or abdominal surface. It has a considerable inclination downwards and backwards, and in a lateral direction, and passes by an insensible transition into the posterior and lateral surfaces of the abdominal cavity. It is perforated posteriorly by a large opening, which transmits the aorta. A second opening, not far removed from this, gives passage to the œsophagus; while there is a third, on the right side, through which the ascending vena cava passes upwards to reach the right auricle of the heart. This latter opening is occasionally double, in consequence of the hepatic vein not uniting with the cava until after it has passed through the diaphragm.

The internal face of the two lateral walls presents nothing remarkable. It is evenly concave throughout, and is smooth and polished on the surface.

The abdominal aspect of the anterior wall is in like manner smooth and concave, but is traversed by four prominent lines, which radiate from a common centre, formed by the umbilicus. The first of these lines consists of a fold of the peritonæum, of a falciform shape, having its narrow extremity directed downwards, which extends from the umbilicus upwards, and engages itself, on the one hand, into the longitudinal fissure of the liver, and on the other ascends upon the anterior face of that organ to the diaphragm to form the falciform or suspensary ligament. The margin of this fold which enters the longitudinal fissure of the liver forms a rounded compact chord called the umbilical ligament, because it is composed of what was the umbilical vein of the fœtus, which after birth becomes obliterated, and is rendered solid. A second fold, or chord, runs from the umbilicus downwards to the fundus of the bladder. It is less distinctly developed than the others, especially in the adult, but

is in the fœtus of considerable magnitude, and forms during that period of existence a canal by which a communication is established between the bladder and the alantoid vesicle of the ovum. This canal is called the urachus. It becomes closed up and obliterated before birth, so as merely to represent a solid chord, formed by a small fold of the peritonæum, having between its duplicatures the obliterated canal. In one case, however, reported by Cabrolus, the urachus remained pervious even after birth (*Observationes Rariores. Obs.* 20. Portal, *Anatomie Médicale*). The bladder and its appendages being developed by the alantoid, the urachus may be with propriety regarded as a prolongation from that vesicle destined for the purpose adverted to.

Leading off from the umbilicus, in a diagonal direction downwards and outwards, another fold or chord exists on each side, which terminates on the side of the fundus of the bladder. It is formed by the remains of the hypogastric, or the umbilical arteries of the fœtus, which are obliterated after birth, and, together with the fold of the peritonæum in which they are included, constitute a solid chord, sometimes called the umbilical ligaments. These bands, as they descend from the umbilicus, gradually recede from each other, so as to leave a considerable space between them of a triangular shape, the base of the triangle being directed downwards. This space is divided in a perpendicular direction into two equal portions by the remains of the urachus, which has been already described as occupying the median line of the abdomen. The umbilical ligament, on each side, as it passes downwards to reach the lateral portion of the fundus of the bladder, becomes more prominent at its lower part, and divides that portion of the internal surface of the abdominal parietes which is situated immediately above Poupart's ligament, into two deep fossæ, which are lined by the peritonæum. The internal, of more limited extent than the external, is bounded internally by the urachus, and externally by the umbilical ligament. This is sometimes called the internal inguinal fossa of the peritonæum. This fossa being fortified anteriorly by the tendon of the rectus muscle, hernial protrusions seldom take place at that point.

The external excavation is much more extensive, and comprises all that space situated between the umbilical ligament and the spine of the ilium. It may, however, be subdivided into two lesser fossa, the first of which is of limited extent, while the other is much larger. The former is small, and is bounded internally by the umbilical ligament, and externally by the epigastric vessels. It is situated immediately behind the external abdominal ring, and may be called crural fossa. It has been designated by Hesselbach *planum inguinum triangulare* (*De ortu et progressu Herniarum*, p. 16, plate vi. k.), and is the point through which the direct inguinal, or inguino-ventral hernia protrudes (*see Hernia*). The external fossa is much more extensive and more profound. It is bounded internally by the epigastric vessels, and externally by the spine of the ilium. Its shape is somewhat triangular, and it represents a kind of hollow pyramid, the base of which is directed backwards and outwards, while the summit, or bottom, extends forwards and inwards, and generally corresponds to the small depression by which the spermatic vessels enter the inguinal canal (Cloquet, *Recherches sur les Hernies de l'Abdomen*, p. 39). This excavation is sometimes so inordinately deep as to contain several folds of the intestines, and is the point at which the parts protrude in the external, or oblique inguinal hernia.

Situated immediately above the symphisis pubis, and behind the attachment of the recti muscles, there is a small triangular prominence, denominated by Breschet *superior pubic ligament*. It is attached by its base to the margin of the bone, while its apex, which is directed upwards, is lost in the linea alba, a little above that point. It fortifies the space between the tendons of the rectus muscles, and has the fascia transversalis attached to its margins.

2. *Structure of the walls of the Abdomen.*—The several regions which have been passed in review are composed of various parts which must next be examined in a general manner. These structures are not only variable in themselves, but are highly important as regards their mutual relations and the influence they exercise both in health and disease.

The remarkable capability possessed by the organs contained within the cavity of the abdomen to undergo a sudden and very considerable augmentation or diminution of volume, renders it absolutely necessary that the walls of the cavity should possess a sufficient degree of mobility to accommodate them to the parts which they contain. This mobility is, moreover, essential to enable the trunk of the body to undergo the various flexures to which it is submitted in different attitudes, and in the

execution of various movements connected with the œconomy of the individual. We accordingly find, that while the posterior portion, which is composed of a movable pile of bones, and which constitutes the proper axis of motion, is solid and resistant, the anterior and lateral are composed of several planes of muscles, aponeuroses, and fasciæ, which, in consequence of the contractility, elasticity, and extensibility with which they are endowed, afford on the one hand a constant means of support to the organs, while on the other they are sufficiently yielding to enable them to accommodate themselves to the different degrees of distension or vacuity of those organs. The support thus afforded is not only important as a means of protection, but likewise in the execution of several functions, as those of vomiting, defecation, labour, respiration, &c., the abdominal muscles antagonizing, as it were, the action of the diaphragm and levator ani muscles, and in thus contracting the abdominal cavity, where all these muscles act in concert, submitting the organs it contains to a considerable degree of pressure, by which they are enabled to contract with greater energy upon their contents during the expulsive effort. Or should the muscles of the anterior wall of the abdomen alone contract, while the diaphragm remains passive, as in the act of expiration, the abdominal viscera will force the latter muscle upwards, and thus diminish the cavity of the thorax.

But while this arrangement favours the purposes which have been enumerated, it necessarily leaves a considerable portion of the organs without that degree of protection against injuries from external causes which they would derive from investing walls of a more solid and unyielding structure, and renders them much more liable to be protruded from their natural cavity. Still, ample means of protection are provided for those organs which, from their mass, solidity, and the fragility of their organization, would be most apt to be seriously injured by external violence. Thus, the liver, spleen, and kidneys, which are of this class, are profoundly situated in a vaulted excavation formed by the cartilages of the ribs and the ensiform cartilage of the sternum, which from their solidity and elasticity are well adapted to ward off any violence to which those organs would otherwise be exposed. The hollow organs, as the stomach and intestines, being more movable and elastic, are less liable to suffer from these causes, and do not consequently require the same protection: but the viscera which are lodged within the cavity of the pelvis, exposed as they are, not only to the gravitating influence of all the organs situated above them, but in like manner to the active impulse communicated to the whole contents of the abdomen by the energetic contraction of its muscles which takes place in the execution of any violent effort, would be constantly forced from their natural cavity, were they not protected by the strong bony walls of the pelvis. This accident is moreover partly obviated by the direction of the superior axis of the abdomen, which is such as to incline the organs downwards and forwards against the lower portion of the anterior walls of the abdomen, where they are forcibly compressed by the contraction of the muscles. This latter disposition, however, while it diminishes the liability of the pelvic organs to displacements, increases the tendency of those of the abdomen to the same accident. We accordingly find, that the most frequent seat of hernial protrusions is precisely at that point against which the intestines are propelled by the contraction of the abdominal muscles (*see Hernia*).

As it is only proposed in this place to make a brief enumeration of the structures which contribute to the formation of the walls of the abdomen, it will not be necessary to say any thing of the posterior and inferior regions of the cavity, the one formed by the spinal column and its muscles, and the other of the bony parts of the pelvis and the soft parts connected with them. We shall, therefore, confine ourselves to the anterior and lateral portion of these walls, or those structures which fill up the space between the ensiform cartilage of the sternum and the margin of the false ribs, and the superior contour of the bones of the pelvis. These parts, when removed from the body, and spread out upon a plane surface, present a broad stratum composed of different parts, which has been very appropriately compared by Beclard to the figure of a lozenge. This stratum is covered externally by the skin, cellular and adipose tissue, and the fascia superficialis, and is lined internally by the peritonæum, fascia propria, and fascia transversalis. Upon this latter surface the peritonæum presents several folds or bands radiating from the umbilicus, which is placed near the centre of the part we are describing, in different directions. All these structures in virtue of their elasticity accommodate themselves with great readiness to the condition of the abdominal organs, while a part of them afford con-

siderable support to those organs, and contribute to fortify those points at which they are most liable to be protruded.

This lozenge-like stratum is attached posteriorly, on each side, to the transverse processes of the lumbar vertebræ; superiorly, to the lower ribs and the ensiform cartilage of the sternum; inferiorly and laterally, to the crista of the ilium and Poupart's ligament, and upon the median line to the spine and symphisis pubis. It is composed, besides the structures which have been enumerated, of five pairs of muscles and their aponeuroses, three of which are broad and expanded, while the other two are narrow and of more limited extent. The three first are spread out upon the whole extent of the region, on each side, and unite by their aponeuroses upon the median line of the abdomen: the two last are placed in a vertical direction on each side of that line, one of them extending from the pubis to the sternum and ribs; the other, merely from the former point to about one third the distance to the umbilicus, where it terminates in the linea alba. (See *Muscles*).

The thin broad muscles, consisting of the external and internal oblique, and the transversales, form a thick and strong stratum, partly fleshy, and partly aponeurotic, which not only affords a powerful support to the abdominal organs, but also acts upon them with great energy in the execution of different functions. At the extreme posterior part, two of these muscles, the internal oblique and transversalis, present a strong aponeurosis by which they are attached to the transverse processes of the lumbar vertebræ, between the layers of which are included the spinal and quadratus lumborum muscles. This region of the abdomen is therefore so well fortified, that a protrusion of the organs cannot take place, except in consequence of some defect of the arrangement. Anterior to this point, the three muscles in question form a thick fleshy stratum, composed of three layers, the fibres of which pursue different directions, those of the external oblique running downwards and forwards, those of the internal upwards and forwards, while those of the transversalis are ranged nearly horizontally. The extent of this fleshy portion varies in the different muscles; in all of them, however, it is terminated anteriorly in a strong expanded aponeurosis, which closes up the whole extent of the anterior portion of the abdomen, from the sternum to the pubis and Poupart's ligament, and from the fleshy portion of the muscle, on one side, to their corresponding portion on the other. The decussation of the fleshy fibres, while it increases the strength of the walls of the abdomen where it exists, enables the muscles to act to greater advantage in depressing the ribs, elevating the pelvis, narrowing the capacity of the cavity of the abdomen, and supporting and compressing its various organs. It is principally in virtue of the ready contraction and relaxation of this fleshy portion of the muscles, that the walls of the abdomen are enabled to accommodate themselves to the distension or vacuity of the viscera, and to impress upon them that influence which is requisite in the performance of some of their functions.

The tendinous, or aponeurotic portion just alluded to, is composed, on each side of the median line, of four strong layers, between two of which are placed the recti and pyramidal muscles, which are thus furnished with a strong sheath, by which they are firmly maintained in their situation, and at the same time have their power very much increased. The aponeurosis of the external oblique comes off from the fleshy portion of the muscle, in the direction of a curved line which extends from the inferior margin of the cartilages of the ribs, to the anterior superior spinous process of the ilium. It is strong, and is composed of conspicuous fibres of a pearly lustre, which are closely bound together by other fibres, which intersect them at oblique angles. Beneath this, we come to the tendon of the internal oblique, which is also strong, but which is divided into an anterior and a posterior layer, the first passing with the aponeurosis of the external oblique in front of the rectus, to form the anterior portion of the sheath; while the second glides behind that muscle, in company with the aponeurosis of the transversalis, to form the posterior portion of the same sheath. Midway between the umbilicus and the pubis, however, all these layers pass in front of the rectus muscle, so that from that point to the symphisis pubis, the posterior portion of the sheath is deficient, or is merely supplied by the fascia transversalis and the peritonæum. The aponeurosis of the three muscles of each side finally meet upon the median line of the abdomen, where an intricate interlacement of their fibres takes place, by which a compact, resistant, white line or band is formed, which extends from the ensiform cartilage of the sternum to the pubis. This narrow band, generally denominated *linea alba*, is perforated towards its inferior third by the umbilicus already described, which in the adult forms a firm compact cicatrix.

The upper portion of the band is much broader than the lower, and as it is consequently more attenuated in the former than in the latter situation, its strength is diminished at that point so as to render the liability to hernia of the linea alba much greater above than below the umbilicus. The line in question is not only formed by the decussation and interlacement of the aponeurotic fibres, but is also fortified by a number of longitudinal fibres, which, however, are less numerous than the others (Cruveilhier, *Dict. de Méd. et de Chirurg. Pratiques. Tom.* I. *Paris*, 1829.) It may be considered as forming the rudiment of a sternum, which in some animals, especially the reptilia, descends to the pubis. The strong and resistant character of this aponeurotic arrangement is peculiarly appropriate to enable the walls of the abdomen to sustain the distending force of the abdominal viscera, that which is created by the gravid uterus, or the accumulation of fluid within the peritonæum. In some instances, however, when the arrangement is unusually feeble, the fibres are forced asunder, under the influence of any violent distending force, and a protrusion of the organs takes place; or when the distension is occasioned by water accumulated within the peritonæum, an aqueous tumor of considerable magnitude may be formed in the course of the linea alba. Professor Siebold (*Encyclopädisches Wörterbuch der Med. Wissenschaften*, *Band* 1. p. 26, Berlin, 1828) reports the case of a female, who during each pregnancy became affected with a protrusion of the former character; and Cruveilhier met with a case of ascites, in which a large aqueous tumor protruded through the parietes of the abdomen. (*Dictionnaire de Médecine et de Chirurgie Pratiques.* Tom. I.)

The recti muscles, which are placed in a perpendicular direction on each side of the linea alba, represent two elongated flattened muscular bands, which pass from the symphisis pubis to the ensiform cartilage of the sternum and the ribs. They are invested by the strong sheath already adverted to, with which they are intimately connected at numerous points, and besides, they present several transverse tendinous intersections, which, by diminishing the length of their fibres, augment their power. The influence of their acts will be different under different circumstances. Passing from the pelvis to the thorax, they assist in sustaining the erect attitude of the body by preventing the inclination of the trunk backwards: they also contribute to flex it forwards, by carrying the ribs downwards, or drawing the anterior part of the pelvis upwards; and in all these acts, when in a state of contraction and while they are antagonized by the diaphragm, they exercise considerable pressure upon the abdominal viscera. The pyramidal muscles, which repose upon the anterior face of their lower extremity, are of but little importance in fortifying the walls of the abdomen. The vessels and nerves of this region will be fully considered under their appropriate heads.

3. *The organs contained within the cavity of the Abdomen.*—Having considered the configuration of the cavity of the abdomen, and the structure of its walls, it will be proper in the next place to take a cursory survey of the organs contained within it, the situation they occupy, and their relations with each other. Previously, however, to entering upon this examination, it will be useful to divide the abdomen into several regions, so that by taking up its different parts in succession, the organs which they contain can be more satisfactorily designated. The information thus afforded is especially important in reference to the subject of diagnosis, inasmuch as it is only by an accurate knowledge of the position and relations of the several organs that we can be enabled to avail ourselves of the advantages afforded by a careful exploration of the abdomen in determining the seats of diseases.

These regions are generally defined by certain arbitrary lines which intersect each other at various points. Thus, it is customary, in the first place, to divide the abdomen into three transverse or horizontal sections, or zones, by means of two lines drawn in a transverse direction. The first line is drawn from the inferior margin of the cartilages of the ribs on one side, to the corresponding point on the other. The space comprised between this line and the superior wall of the abdomen constitutes what is denominated the *Epigastric region*, (*regio epigastrica.*) If a second line be extended from one spinous process of the ilium to the other, it will designate two other sections, or zones; one comprised between the second and the first line, called the *mesogastric region* (*regio mesogastrica ;*) the other, situated below the second line, and between it and the lower wall of the abdomen denominated the *Hypogastric region*, (*regio Hypogastrica.*) Each of these regions is subdivided into three by means of a line descending in nearly a perpendicular direction, on each side, commencing from the acromial extremity of the clavicle, and

terminating at the spine of the pubis, or at the point at which the inferior pillar of the external abdominal ring is attached to that bone. Of these subdivisions, one is situated on each side, and one upon the median line. The central portion of the epigastric region constitutes the *regio epigastrica stricte sic dicta*, while those on each side are called the right and left *hypochondriac regions*, (*regio hypochondriaca dextra et sinistra.*) The central portion of the mesogastric zone constitutes the *umbilical* region (*regio umbilicalis:*) the lateral portions the right and left *lumbar regions*, (*regiones lumbares.*) The middle portion of the hypogastric zone is denominated the hypogastric region, (*regio hypogastrica:*) while its lateral portions are called the right and left *iliac regions*, (*regiones iliacæ.*) See *Exploration* for Figures.

Contained within the cavity formed by the assemblage of these several regions are three classes of organs proper to the cavity itself, besides several other structures, consisting of arteries, veins, lymphatics, nerves, &c. which also exist in other situations. The first set of organs consists of those which are concerned in the process of digestion, which may be divided into the alimentary canal and its investing folds, and the glands which are engrafted upon it. The canal represents an elongated tube of variable dimensions at different points, commencing at the diaphragm, and terminating at the anus. It is folded upon itself in a very complicated manner, and consists of the stomach, and the small and large intestines. All these are covered, or tied down, by several folds of the peritonæum, consisting of the omentum, the mesocolon, and the mesentery. These are so disposed as to allow particular portions of the tube to float with considerable freedom within the cavity, so that their position is subjected to frequent changes. The glands which are engrafted upon the alimentary canal are, the liver, with its appendages, the spleen and pancreas. The second class of organs is composed of the kidneys, the renal capsules, the ureters and bladder. The generative apparatus contained within the cavity of the abdomen consist, in the male, of the vas deferens, vesiculæ seminales, and the prostate gland; in the female, of the uterus, ovariæ, fallopian tubes, and vagina. Reposing upon the posterior wall of the abdomen, and behind the peritonæum, we have in the upper part, the aorta, vena cava, cœliac, mesenteric, emulgent and spermatic vessels, a portion of the pneumogastric and ganglionic nerves, the receptaculum chyli, and lymphatic glands: inferiorly, the iliac arteries and veins, and the lumbar and sacral nerves, together with the hypogastric plexus of the ganglionic system.

None of the organs which have been enumerated are situated within the cavity of the peritonæum, but are placed behind it. That membrane, however, is reflected over the surface of a large proportion of them; only a few being destitute of any connexion with it.

In consequence of the concavity of the diaphragm, and the descent of the cartilages of the ribs on each side, and of the ensiform cartilage upon the median line, in front of the organs contained within the epigastric zone, a considerable portion of those organs is concealed from the touch, so as to render their exploration more difficult. During a forcible inspiration, however, the diaphragm, in its descent, carries the liver before it, so as to expose a greater extent of its lobes below the level of the margin of the ribs.

In the *right hypochondriac* region we have the right lobe of the liver, concealed for the most part anteriorly by the ribs; the gall bladder and the biliary ducts; a portion of the branches of the hepatic artery and the portal vein; the upper portion of the right kidney, with its suprarenal capsule; the upper part of the ascending, and the commencement of the transverse arch of the colon, together with the corresponding portion of the mesocolon. The gall bladder, which, when distended, frequently has its fundus projecting slightly beyond the margin of the liver, is generally situated immediately behind the cartilage of the second rib. Immediately beneath its neck is a considerable opening, denominated foramen of Winslow, leading into what is improperly denominated the posterior cavity of the peritonæum, which is situated behind the liver and stomach. Below the margin of the liver, and near the fundus of the gall bladder, the colon makes a gradual sweep towards the left side, which forms the commencement of its transverse arch. Behind this, and profoundly situated, are the first and second portions of the duodenum, with the head of the pancreas reposing in the curvature of the intestine; the pyloric orifice of the stomach, a part of the emulgent vessels, and the hepatic and renal plexus of nerves.

The *left hypochondriac* region, which, like the right, is protected by the ribs, contains the spleen, connected to the greater extremity of the stomach by the duplicature of the peritonæum called gastro-splenic

ligament, and reposing upon the corresponding portion of the colon; the splenic artery and vein; the superior portion of the left kidney and its suprarenal capsule, with their vessels; the vasa brevia, passing from the spleen to the stomach; the greater extremity or *cul de sac* of the stomach, and the tail, or left extremity of the pancreas.

The *epigastric* region, properly so called, is occupied by the left lobe of the liver, which overlaps the anterior face of the stomach, and in some cases extends into the left hypochondriac region; by all that portion of the stomach which is not included in the two regions just described; and towards the left side, and above, by the cardiac orifice of that organ, and the termination of the œsophagus, surrounded by the pneumogastric nerves. Between the lesser curvature of the stomach and the liver there is a duplicature of the peritonæum denominated the lesser omentum, containing a part of the vessels and nerves of the stomach. Below the stomach, the transverse arch of the colon sweeps across the abdomen, maintained in its situation by a large fold of the peritonæum called the transverse mesocolon, between the layers of which is situated the transverse portion of the duodenum, where it reposes upon the anterior part of the spinal column. This fold forms a limit between the epigastric and umbilical regions. The greater omentum, descending from the greater curvature of the stomach, passes downwards in front of the transverse arch of the colon, except its posterior layer, and extends into the umbilical region. Behind all these parts, and profoundly situated, we find the body of the pancreas, extending obliquely across the spine; the aorta escaping from between the pillars of the diaphragm; the cœliac artery giving off its three branches; the phrenic and superior mesenteric arteries; the semilunar ganglion, and solar plexus of nerves; the inferior portion of the thoracic duct, and towards the right side, the ascending vena cava. The situation of the aorta, cœliac artery, and the semilunar ganglion and solar plexus behind the stomach, explains the source of the violent pulsations which are sometimes observed in the epigastrium. (See *Abdomen, pulsations in the. Art.* iv. § 13.)

The *right lumbar* region is traversed by the ascending colon, which mounts upwards in nearly a perpendicular direction, and is fastened down by the right mesocolon. This region also contains several convolutions of the small intestines, and in its upper part, the inferior portion of the kidney, from whence the ureter descends towards the bladder.

The descending portion of the colon, some convolutions of the small intestines, the inferior portion of the left kidney, and the ureter, occupy the left *lumbar region.*

In the *umbilical region*, the great omentum is spread out like an apron in front of the small intestines, and the whole region is filled up by the numerous convolutions of the jejunum and ileon, which float within the cavity merely attached by their great mesenteric fold of the peritonæum. This duplicature is traversed by the mesenteric vessels and nerves, and the chyliferous vessels, and contains within its fold numerous lymphatic glands which frequently become enlarged. The aorta descends upon the anterior face of the lumbar vertebræ, accompanied by the vena cava which is situated upon its right side.

The left iliac region is occupied by a part of the sigmoid flexure of the colon, numerous convolutions of the small intestines, the left ovaria and a portion of the fallopian tube, a part of the vas deferens, a portion of the external iliac artery and vein, and the anterior crural nerve. The right contains the cæcum and vermiform appendix, the termination of the ileon and the commencement of the colon, but in other respects is similar to the left.

In the hypogastric region are lodged a number of convolutions of the small intestines, a part of which descend into the deep cul de sac of the peritonæum situated between the bladder and rectum. Below and in front, the bladder reposes behind the symphisis pubis; on each side the vas deferens descends into the cavity of the pelvis; and below the bladder are situated the vesiculæ seminales, and in front of them, the prostate gland and ejaculatory ducts. Posteriorly and superiorly, we have the promontory of the sacrum, and a little on the left side, the rectum, descending in nearly a perpendicular direction, tied down by a fold of the peritonæum. On each side the ureter descends obliquely towards the lower fundus of the bladder. In the female, the uterus and vagina are interposed between the pubis and the bladder, and the former sends off, on each side, the fallopian tube, and the round and broad ligaments, a portion of all of which are contained within the hypogastric region. (*For further details, see Pelvis* and *Perinæum*).

4. *Modifications to which the Abdomen is submitted by age.*—During the early months of fœtal existence, the

anterior walls of the abdomen are deficient, and the organs are merely covered by the peritonæum. At a later period they become closed upon the median line, when they are merely perforated by the umbilical vessels—the size of the cavity at this time is larger, in proportion to that of the thorax, than at any other period of life; so much so, indeed, that according to the observations of Portal (*Anatomie Médicale*, Tom. V. p. 97), the distance between the sternum and pubis is equal to one third the whole length of the body, whereas, in the adult, it does not amount to more than one fifth. But notwithstanding the entire cavity of the abdomen presents this great preponderance of development during the earlier periods of existence, this is by no means the case with all its parts. The epigastric and hypogastric regions are remarkably small compared to the mesogastric or umbilical, and nearly the whole of the organs are contained within this latter portion of the cavity. The diaphragm presents nearly a plane surface; the ribs are inclined outwards, and the stomach, liver, and spleen, which are subsequently concealed by them, are situated much lower down, and extend even to the umbilicus. The liver is much larger in proportion to the other organs than it is in the adult: its left lobe is also larger and encroaches more upon the stomach, which is placed, during the early months, in nearly a perpendicular direction, having its greater curvature inclined to the left side and the omentum coming off from it in that direction, while its lesser curvature is inclined to the right. The duodenum, more folded than in the adult, is situated behind the stomach, and the spleen, as well as the liver, descends so low as to be easily felt through the walls of the abdomen. The spinal column is nearly straight, so that the mesogastric portion of the abdomen presents a greater diameter from behind forward than at a subsequent period of life, while the same disposition of the sacrum diminishes the capacity of the pelvis, in consequence of that bone approaching nearer to the symphisis pubis, its concavity not being yet developed. The tuberosities of the ischium are imperfectly formed, and the pelvis is remarkably shallow. It is also contracted in its transverse direction. These conditions, together with the narrowness of the symphisis pubis, throw nearly the whole of the pelvic organs above its brim; and the bladder, situated almost entirely above the pubis, when distended, nearly reaches the umbilicus. The uterus, ovaria, and fallopian tubes are also, in great part, situated above the level of the brim of the pelvis. At the expiration of five years, however, nearly all these relations become changed. The diaphragm becomes more concave; the subdiaphragmatic excavation is increased; the ribs are inclined more inwards, the breadth of their cartilages is increased, the comparative volume of the left lobe of the liver is diminished, and the whole of that organ, with the stomach and spleen, are carried upwards so as to be placed behind the ribs and the ensiform cartilage of the sternum; the stomach is inclined more to the transverse direction, and the omentum, which passes off from its great curvature, descends into the umbilical region, and is spread out in front of the other organs. The depth of the pelvis also increases; its transverse and antero-posterior diameters are augmented, and the bladder, together with the uterus and its appendages, descend into that cavity, and a considerable portion of the convolutions of the small intestines becomes lodged in the deep cul de sac of the peritonæum situated between the bladder and rectum.

Various other changes in the volume, situation, and relations, of the abdominal organs, might be mentioned, but they appertain rather to a pathological condition, and will be described under another head.

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2. *Surgical Anatomy of the Abdomen.* The walls of the abdomen, from the structure and disposition of the parts of which they are composed, are liable to a number of formidable accidents and diseases which call for the assistance of the surgeon. To properly comprehend the nature of these accidents, and to be able to institute an appropriate method of treatment for their relief, it is indispensably necessary to be well informed relative to the structure of the parts concerned, their relations with each other, and the influence they are capable of exercising upon the parts involved in the disease. Having, therefore, described the different parts of

the abdomen, and made a brief examination of the situation and relation of the organs contained within its cavity, we shall now consider, in a cursory manner, the relations of these parts with the diseases and accidents to which they are liable.

Anterior and Lateral Walls of the Abdomen.—It will be proper to consider the anterior and lateral walls of the abdominal parietes in conjunction, inasmuch as the parts of which they are composed are so similar, and so intimately connected, that they cannot be well separated.

The skin, throughout the whole extent of this region, is thin and yielding, but is somewhat thicker posteriorly than anteriorly. Upon the median line, especially towards its lower part, it is of a darker color than at other points, and is in the male covered with numerous hairs. It contains a considerable number of sebacious follicles, which are embedded in its substance, and which sometimes become the seat of disease. At most points the skin is loose and movable, but along the course of the linea alba it is more firmly attached. At the umbilicus this connexion is so intimate, that the navel, in those who are corpulent, exhibits a deep depression or cicatrix. At all other points it is highly extensible, and yields readily to the distension occasioned by various tumors, by hernial protrusions, by an enlargement of the ovaria, by ascites, pregnancy, &c., and resumes its former condition so soon as the distending force is removed. In those females, however, who have borne numerous children, the repeated acts of distension to which it is submitted, render it thicker and more compact, and impart to it a folded or corrugated character.

Immediately beneath the skin there is a considerable stratum of cellular and adipose tissue, the thickness and density of which vary at different points, and under different states of the system. When this is examined with attention, it is found to be composed of two layers, which, though intimately connected with each other, can nevertheless be easily separated. These parts, thus isolated, form a kind of membranous expansion, composed of compact lamellated cellular tissue, frequently intermixed with small pelets of adipose substance, which invests the whole parietes of the abdomen, and which was long since noticed by Camper (*Icones Herniarum*, p. 11), and which has been since described by Sir A. Cooper, under the appellation of *Fascia Superficialis Abdominis.*

The Fascia Superficialis, therefore, consists merely of a condensed arrangement of the subcutaneous cellular tissue, which is so disposed as to form two laminæ, the one resting upon the other, the external of which is intimately connected with the internal face of the skin, by means of filamentous tissue, intermixed with small globules of adipose tissue which are embedded in the substance of the derm, while the other adheres to the outer face of the abdominal muscles and their aponeurosis, though much less intimately with the latter than the former.

Occupying the whole superficies of the walls of the abdomen, the superficial fascia may be traced from thence upwards upon the anterior part of the thorax and neck, where it constitutes the superficial fascia of those regions; laterally, it passes round into the lumbar region, where it degenerates into loose cellular tissue; and downwards and outwards, it passes over the crista of the ilium, to reach the surface of the glutei muscles, upon which it continues with the common cellular tissue. Upon the median line of the abdomen, it continues with the fascia of the opposite side, and is at that point intimately connected with the linea alba, except in the vicinity of the pubis, where it also becomes looser in its arrangement, and exhibits a lamellated structure, in which is generally deposited a quantity of adeps, by which a prominence is formed called the *mons veneris.* In its course downwards, the fascia superficialis becomes much stronger, especially in the vicinity of Poupart's ligament and the external abdominal ring. Internally, the lower part of the superficial fascia sends a prolongation downwards upon the penis, and a second into the scrotum, which, with a similar slip of a delicate attenuated character which is sent off from the contour of the ring, descends into the bottom of the scrotum, and forms a kind of elongated cul de sac, which surrounds the spermatic chord and tunica vaginalis, and becomes confounded below with a whitish colored fibro-ligamentous band of a triangular shape, which connects the testicle with the scrotum, and which consists of the remains of the *gubernaculum testis* of Hunter. This portion of the fascia, though thin and transparent in its natural state, becomes very much thickened when distended by hernial protrusions. In front of Poupart's ligament, the superficial layer of the fascia continues its course downwards upon the groin, in front of the superficial inguinal glands, sending off from its internal surface numerous slips by which those glands are invested, and finally adhering to the small fossa which

transmits the saphena vein of the thigh, and becoming continuous, on the one hand, with the crural sheath, while on the other it is gradually lost upon the surface of the fascia lata.

The *profound layer of the fascia* adheres, though not intimately, with Poupart's ligament; descends a few lines below its border, the distance to which it descends being somewhat greater internally than externally, and is reflected upon itself backwards and upwards, so as to form a kind of furrow, or groove, which ranges parallel with the ligament. The margin of this reflected portion is attached externally to the whole extent of the anterior face of the superficial layer of the fascia lata, while, at its internal part, it mounts upwards, in company with the upper extremity of the falciform process of the fascia lata, behind the inner part of the inferior pillar of the ring, and is inserted with that process into the crista of the pubis, where they fortify Gimbernat's ligament (Manec, *Recherches Anatomico-Pathologiques sur la Hernie Crurale*, p. 13. plate 1. Paris, 1826.), and into the neighboring part of the pectinæal portion of the fascia lata.

This arrangement can be easily rendered manifest by a careful dissection of the parts; but it will become strikingly obvious, if the two layers of the fascia be first inflated, as recommended by Dr. Darrach. According to his observations, if air be forced into the cells of the outer lamina of the fascia superficialis, at any point on the surface of the abdomen, or the anterior part of the thigh, it will freely pass over the abdominal, crural, genital, and perinæal regions; demonstrating that these regions have a *common* subcutaneous cellular covering. But when air is forced into the cells of the deeper seated lamina, its diffusion will be partial. The inflation being made from any point on the anterior part of the thigh, the air will not, without the strongest effort, pass above the inguinal line: the cellular tissue of the thigh will be found distended, that of the abdomen remaining collapsed. The air will force a passage by the *crural ring* into the iliac region, thereby separating the peritonæum from the fascial covering of the iliac and psoas muscles. Again, air blown into the deeper seated laminæ from any point on the abdomen, will also be limited by the inguinal line. It will distend the surface of the penis, together with the scrotum and perinæum, without in the least affecting the thigh; nor can the air be made to pass into the crural region, even when the pressure is augmented, owing to the adherence and reflection upwards of the deeper seated abdominal laminæ, at the inguinal line. Increased pressure will, in this case, drive the air backward into the abdominal ring, between its edges and the subjacent uninflated cellular sheath of the spermatic chord and testicle. (Darrach, *Anatomy of the Groin*, p. 14. fol. Philadelphia, 1830.)

It has been stated by Jules Cloquet, (*Recherches Anatomiques sur les Hernies Abdominales*, p. 11. Paris, 1817.) that in the fœtus, previous to the descent of the testicle, the fascia superficialis is doubled upon itself in such a manner, where it reposes in front of the abdominal ring, as to furnish a prolongation, which passes upwards through the inguinal canal, to be implanted into the testicle and the epididymus, and thus to form the *gubernaculum testis.* This opinion, however, has been controverted by Manec, who states, that in dissecting the body of an individual whose testicles had never descended from the abdomen, the fascia superficialis merely glided in front of the ring, and was but feebly attached to the inferior extremity of the gubernaculum, which descended a few lines below the inferior orifice of the inguinal canal. (*Recherches sur la Hernie Crurale*, p. 15.)

The delicate attenuated character of the *fascia superficialis* renders it incapable of furnishing much support to the abdomen; but when it is brought in relation with a hernial protrusion, it becomes so much thickened by irritation and adhesive inflammation, as to constitute an important constituent part of the sac.

The *muscles* which enter into the composition of the *anterior and lateral walls of the abdomen*, consist of five pairs, of which three are broad, and with their expanded aponeuroses are spread over nearly the whole extent of the regions in question, while the other two are narrow, and are placed in a vertical direction, on each side of the median line. (See *Muscles of the Abdomen.*)

The posterior and superior portion of the external oblique muscle, which is broad, expanded, and fleshy, is attached above by eight distinct digitations to the outer face of the eight inferior ribs, from whence its fibres take an oblique inclination downwards and forwards, those which appertain to the upper portion of the muscle taking nearly a transverse direction towards the linea alba, while the others become more oblique in proportion as they are situated lower down. The posterior fibres terminate in the crista and spine of the ilium, while all

the others form a broad tendinous aponeurosis, the whole of the upper portion of which advances in front of the rectus muscle, and has its fibres interlaced upon the course of the linea alba; that portion which forms its inferior margin, and which is attached to the spine of the ilium, taking its course downwards and inwards to be inserted into the symphisis and spine of the pubis. This inferior margin, which presents a rounded border having a slight curvature with its convexity downwards, constitutes what is called ***Poupart's ligament***, which merits a special consideration. The aponeurosis of the external oblique muscle is composed of shining, parallel, tendinous fibres, which, however, do not exhibit the same arrangement and strength at every point. They are slender and delicate above, but become much stronger below, and are frequently disposed in ribbon-like fasciculi, which are separated by slight intervals. Two of these fasciculi, stronger and more distinctly marked than the others, which form the inferior portion of the tendon, as they approach the pubis gradually separate or recede from each other, to form a small triangular or oval aperture, called the external abdominal ring, which transmits the spermatic chord in the male, and the round ligament of the uterus in the female. That portion of the tendon which forms the superior and internal boundary of this opening, is called the superior, or internal pillar of the ring. Its fibres reach the symphisis pubis, where a portion of them interlace with the corresponding fibres of the opposite side, while the others descend in front of the bone to strengthen its articulation, and to fortify the suspensory ligament of the penis. The other band, which constitutes the inferior and external boundary of the opening, is denominated the inferior, or external pillar of the ring. Its arrangement is much more complicated, and when examined in its isolated state, seems to have its lower margin reflected upwards and inwards, so as to form a kind of furrow, or groove, upon its upper surface, which is directed towards the cavity of the abdomen. This folding is, however, only apparent, although it has been generally thus described by anatomists; the appearance in question being formed by a disposition of the fibres of the tendon which was first correctly described by Manec (*Recherches sur la Hernie Crurale*, p. 16, plate 2, fig. 2, 5.). The outer extremity of these fibres is attached to the inferior part of the crista, and to the spine of the ilium, from whence those which form the part of the ligament which is in immediate relation with the ring, advance downwards and inwards, and become attached to the spine of the pubis, while those which are attached lower down to the spine of the ilium, pursuing the same direction until they arrive near the pubis, instead of being attached to the spine of that bone, are inclined backwards and slightly inwards, to terminate on the outside of the spine upon the commencement of the prominent line called the crista of the pubis. A necessary consequence of this arrangement is, that the fibres of this portion of ***Poupart's ligament*** are shorter, in proportion as they are more external and inferior, and that in proportion as this diminution of length takes place, they cannot reach the spine of the pubis, but are inserted into its crista. In some instances these fibres, instead of being inserted into the bone, merely interlace with those of the profound layer of the fascia lata, in the vicinity of the posterior border of the pubis, and with the tip of the falciform process of the superficial layer of the same fascia, where it terminates in the crista of the pubis.

This junction of the fibres of the tendon of the external oblique muscle with the crista of the pubis, together with their interlacement with those of the two portions of the fascia lata above adverted to, forms a small triangular aponeurosis, denominated ***Gimbernat's ligament***, the summit of which is directed inwards and the base outwards towards the iliac vessels. This expansion presents a thin crescentic edge, which is inclined towards the crural vessels, and forms the inner boundary of a small oval aperture called the *crural ring*, through which the viscera protrude in *femoral* or *crural hernia*. The part mentioned under the appellation of *Gimbernat's ligament*, is the upper portion of the expansion denominated by Mr. Hey (*Practical Observations in Surgery*, p. 151. Lond. 1803.) *femoral ligament*, the lower portion consisting of the falciform process of the fascia lata with which it is continuous. Boyer called it the *reflected portion of the external pillar of the ring*, and Manec (*Op. Cit.* p. 18.) has proposed to denominate it the *posterior pillar* of the external oblique muscle. It has an important relation with the parts concerned in the protrusion in crural hernia, and was supposed by Gimbernat (*Nuevo Methodo de Operar en la Hern.* &c. Madrid, 1793.) and Hey to constitute the seat of stricture in that accident; an opinion which has been in part adopted by many surgeons since that period.

It has been stated that *Poupart's ligament* presents a slight convexity which is directed towards the thigh. This is occasioned by the outer fourth of its inferior margin being attached to the superficial layer of the fascia lata, which, when it is put upon the stretch, draws the corresponding portion of the ligament downwards, so as to increase the convexity of its border. Further inwards, Poupart's ligament merely glides in front of that portion of the superficial layer of the fascia lata which reposes upon the anterior face of the psoas magnus and iliacus internus muscles; and beyond that point, and still further inwards, it passes in front of the crural vessels, and the crural ring, until it reaches the spine and crista of the pubis. Those portions of it which are situated in front of the vessels and the crural ring, are fortified, upon their posterior face, by that part of the superficial layer of the fascia lata which passes upwards behind the ligament to become continuous with the *fascia transversalis*, which lines the internal face of the walls of the abdomen.

The tendon of the external oblique, at its lower part, and the external abdominal ring, are fortified by an arrangement which still remains to be described. This is accomplished by several small tendinous bands which mount obliquely upwards and inwards upon the anterior face of the tendon, so as to cross its fibres at oblique angles, and by adhering intimately with them, to form a strong bond of union between their several fasciculi, which prevents them from separating from each other. These *bands* may be divided into two orders; one external, the other internal, which we shall, with Dr. Darrach, denominate *crural* and *abdominal.*

The crural portion commences, in form of a strong fasciculus, from that portion of the fascia lata comprised between the spine of the ilium and the point at which the anterior crural nerve escapes from the cavity of the abdomen, and where it is intimately united with *Poupart's ligament*, as described above. From thence, it takes a circular sweep upwards and inwards, and divides into several smaller fasciculi, which gradually receding from each other, are spread out upon the anterior and posterior face of the tendon of the external oblique, and by becoming inseparably interwoven with its fibres, which they cross at oblique angles, form a kind of web of great strength. (Darrach, *Anatomy of the Groin*, p. 22, plate 2.) These bands are very unequally developed in different subjects, being in general much stronger in stout males than in those of feeble conformation, but in some subjects so indistinct as not to be discovered by the most careful dissection; a circumstance which led Winslow to assert that they do not exist in the child, and even to doubt their existence in the female. Scarpa, however, states, that he has always discovered them in such subjects, as well as in the male, whenever he has sought them with attention. (*Memorie Anatomico-Chirurgiche sull' Ernie*, p. 3. Pavia, 1819.)

The second portion, or abdominal fasciculus, is much stronger, and performs an important part in relation to the external abdominal ring. It was first accurately described and delineated by Darrach. (*Op. Cit.* p. 20, plate 2.) He supposes that it takes its origin from the tendinous fibres of the internal oblique muscle of the opposite side. It first makes its appearance in front of the tendon of the external oblique, near the median line, and a little above the pubis, after which it seems to penetrate behind a ribbon-like fasciculus of its fibres, and again emerges a little above, and on the inner side of the ring. At this latter point, the two fasciculi of which it is composed separate from each other, and both advancing obliquely downwards and outwards, the external spreads its fibres upon the inferior edge of that portion of Poupart's ligament which is in front of the crural vessels, and finally terminates by interweaving itself with the deeper part of the fascia lata which forms the anterior part of the crural sheath. The inner portion crosses the split of the tendon which forms the two pillars of the ring, with which its fibres are intimately interwoven, and forms a concave border directed towards the pubis, which forms the superior and external boundary of that opening. Beyond this point, its fibres are spread out upon the internal portion of the inferior pillar of the ring, a portion of them interlacing with the anterior face of the upper extremity of the falciform process of the fascia lata, while the most internal are reflected upwards and backwards with the tip of that process, and interlace with those fibres which form the posterior insertion of the tendon of the external oblique muscle, or *Gimbernat's ligament.** By this arrangement the triangular split of the tendon of the oblique muscle is converted into an elongated oval aperture, the longest diameter of which ranges in a direction upwards and outwards, the lower extremity

* In our own dissections, we have generally found that these *abdominal bands* proceed from the tendon of the external oblique of the opposite side,

of which is bounded by the pubis, the upper by the abdominal fasciculus, which binds the two pillars together, so that they cannot be separated from each other, and externally and internally by the corresponding pillars of the ring itself. While therefore sufficient space is thus allowed for the spermatic chord, the abdominal ring is so fortified by the fasciculus in question as to greatly diminish the liability to hernial protrusions, which would otherwise be apt to take place, in consequence of the ready separation of the two pillars of the ring. When, however, these protrusions do occur, the arrangement in question constitutes the most frequent cause of stricture when it takes place at the external opening; for these fibres, taking their origin as they do from the internal oblique of the opposite side, and passing across the upper part of the ring to be attached to the fascia lata and the crista of the pubis below, the contraction of the muscle, extending its influence through them, will tend to constrict the protruded parts, and give rise to strangulation. Hence the efficacy, in some cases, of those means which enfeeble muscular contraction in facilitating the reduction by taxis, and especially the importance, when that operation is to be attempted, of flexing the thigh upon the pelvis, and carrying it inwards so as to relax the fibres by which the constriction is kept up. The same considerations, moreover, suggest the advantage of directing the incision upwards and outwards, so as to divide the abdominal fasciculus of fibres, at the upper part of the ring, when the stricture takes place at that opening.

The umbilical and epigastric portions of the aponeurosis of the external oblique have less important pathological relations, and are also less complicated in their attachments. The broad tendon of the muscle is, throughout the whole extent of these regions, spread out in front of the aponeurosis of the internal oblique muscle, with the anterior layer of which it passes before the rectus muscle, to form the anterior portion of its sheath, and to unite with the tendons of the other muscles at the linea alba, where they all form a kind of interlacement extending from the sternum to the symphisis pubis. The pathological relations of this portion of the tendon of the external oblique can be better understood after the aponeurosis of the internal oblique and transversalis have been described.

The internal oblique muscle is placed between the external oblique and transversalis, and is composed of divergent fibres, which, unlike those of the external oblique, mount upwards and forwards. Superiorly, it is attached to the inferior part of the tenth, eleventh, and twelfth ribs; posteriorly, by the fascia lumborum, to the spinous and transverse processes of the lumbar vertebræ; inferiorly and externally, to the crista and spine of the ilium, between the attachments of the external oblique and transversalis, and to the outer third of Poupart's ligament. From these points of origin the fibres of the internal oblique advance forwards and upwards, gradually receding from each other, and when they arrive at the linea semilunaris, terminate in a broad aponeurosis which immediately divides into an anterior and a posterior layer, the first of which passes in front of the rectus muscle in company with the tendon of the external oblique, to the linea alba, while the second passes behind that muscle, with the tendon of the transversalis, to terminate at the same point. In consequence of this arrangement, the rectus is included in a strong aponeurotic sheath, formed anteriorly by the tendon of the external oblique and the anterior layer of the tendon of the internal oblique, and posteriorly by the posterior layer of the tendon of the internal oblique, and the tendon of the transversalis. Above the level of the ninth rib, however, no such division of the tendon takes place, the whole of it passing in front of the rectus, while the posterior portion of that muscle reposes in immediate contact with the tendon of the transversalis and the cartilages of the ribs. At a point situated midway between the umbilicus and the symphisis pubis, the posterior layer of the tendon of the internal oblique, as well as the tendon of the transversalis, forms a concave margin, the border of which is directed downwards; and between that point and the pubis, the tendons of the three muscles all pass in front of the rectus, while the posterior face of that portion of that muscle is merely separated from the peritonæum by the fascia propria and the fascia transversalis.

The fibres which form the inferior margin of the internal oblique muscle, and which are attached to Poupart's ligament, are inclined inwards and slightly downwards, making a semicircular sweep over, and in front of, the spermatic chord where it emerges from the abdomen, and terminate in a thin aponeurosis, which is inseparably connected with the corresponding portion of the tendon of the transversalis, with which it is inserted into the superior part of the pubis from the symphisis to the

spine, and thus closes up the space immediately behind the external abdominal ring, so that the finger introduced through that opening cannot be passed directly backwards into the cavity of the abdomen. The inferior fibres of the muscle are slender and loose in their connexions, and a portion of them are carried down in the descent of testicles, in form of elongated loops, and thus form the *cremaster muscle*, which will be presently described.

The transversalis muscle is situated immediately beneath the last, and is attached superiorly to the internal surface of the cartilages of the seven inferior ribs, by the same number of slips, which digitate with those of the diaphragm; posteriorly, to the fascia lumborum; inferiorly and externally, to the inner labium of the crista of the ilium, the spine of the ilium, and the posterior margin of the external portion of Poupart's ligament. The fibres advancing forwards, terminate in a broad aponeurosis, which advances behind the rectus, except at its inferior part, to form, with the posterior layer of the tendon of the internal oblique, the posterior portion of the sheath of that muscle, and is inserted into the ensiform cartilage of the sternum, and the whole extent of the linea alba. Below the central point between the umbilicus and the pubis, this tendon passes in front of the rectus, so as to leave that portion of its sheath deficient at its posterior part.

Those fibres of the transversalis which come from Poupart's ligament take a direction inwards and obliquely downwards, arch over the spermatic chord like the fibres of the internal oblique, and terminate in a flattened aponeurosis which presents a concave margin directed downwards and outwards. This aponeurosis unites with the corresponding portion of the tendon of the internal oblique, and is inserted into the upper and back part of the pubis throughout the whole extent from the symphisis to the spine, into the linea ilio-pectinæa where its fibres interlace with *Gimbernat's ligament*, and at that point it becomes inseparably connected with the *fascia transversalis*. By these numerous connexions, the space situated immediately behind the external abdominal ring is completely closed up and fortified, so as to render difficult a protrusion of the viscera of the abdomen directly forwards. (Sir A. Cooper *on the Anatomy and Surgical Treatment of Abdominal Hernia*, p. 5. Part 2, plate 2. *Fol.* Lond. 1827.) The transversalis muscle does not usually descend quite so low as the internal oblique, but its inferior fibres present the same loose arrangement, and a portion of them are frequently carried down before the testicle to form the cremaster muscle.

The *cremaster* muscle consists of a small fasciculus of fibres, which has been generally described as descending from the outer part of Poupart's ligament, where it is connected with the internal oblique muscle, to the body of the testicle, so as to lose its fibres upon the surface of that organ. This error was first exposed by Hesselbach (*De Ortu et Progressu Herniarum*, p. 17. 1816.), and has been subsequently corrected by Jules Cloquet (*Op. Cit.* p. 14, plate 2), whose opinion has been adopted by a majority of modern anatomists. According to the observations of this gentleman, the *cremaster* does not exist before the period at which the testicle of the fœtus descends from the cavity of the abdomen into the scrotum, and is formed at the expense of the inferior fibres of the internal oblique muscle, and sometimes of those of the transversalis, which are gradually elongated, and carried down before the testicle in form of slender loops of unequal length. The fibres of which these loops are composed are attached, externally, to Poupart's ligament, at its junction with the internal oblique, where they are fleshy and distinct; internally, to the spine of the pubis immediately behind the inferior pillar of the external abdominal ring. The inner portion of the fibres, which is attached to this latter point, is generally pale, slender, and indistinct; though in stout muscular subjects it frequently consists of a stout fasciculus of a triangular configuration; and the reason why it is generally so indistinct in its appearance is, that the internal oblique muscle is ordinarily attached to the pubis by slender aponeurotic fibres, which of course become elongated to form the inner portion of the cremaster muscle. In all cases, the fibrous loops are sparsely spread out upon the anterior part of the testicle and the spermatic chord, exterior to the *tunica vaginalis testis*—are longer in proportion as they are situated lower down—have their concavity directed upwards, and their convexity in an opposite direction—and are so disposed, that in the vicinity of the ring their fibres are collected into two elongated fasciculi of unequal magnitude, the external of which, the stronger of the two, enters the ring upon the external and anterior portion of the spermatic chord to attach itself to Poupart's ligament, while the internal enters the same aperture near its internal part, to become attached to the

spine of the pubis. The testicle is, by this arrangement, suspended in the muscular loops which are carried down before it, and is elevated or depressed according to the state of contraction or relaxation of the muscle. As, moreover, the fibres of the cremaster are spread out upon the surface of the chord and the tunica vaginalis, their contraction may present a slight obstacle to the protrusion of an inguinal hernia, or assist in forcing it back into the abdomen, where it has already protruded. In all cases, where a protrusion of this kind has existed for some time, the fibres of the muscle, together with their connecting cellular tissue, become considerably thickened, and contribute considerably to the formation of the sac.

The *rectus* muscle, of an elongated flattened configuration, is situated by the side of the median line of the anterior walls of the abdomen, and extends from the symphisis pubis to the lower part of the sternum and ribs. Above, it is attached by several digitations of unequal length to the anterior face of the ensiform cartilage, and to the cartilages of the fifth, sixth, and seventh ribs; below, it terminates by a broad flat tendon which is attached behind the pyramidalis muscle to the superior portion of the body of the pubis, in front of which some of its fibres descend as low as the suspensory ligament of the penis. The tendon of one side generally overlaps, to a small extent, that of the other, and in some instances an interlacement of the fibres takes place, by which the parts are firmly united. The external border of the tendon is acute, and is frequently united with a portion of the fascia transversalis, though in many instances no such junction takes place, but the fascia passes behind the muscle and its tendon, while the tendon of the transversalis abdominis passes in front.

The *pyramidalis* is a small muscle of a pyramidal shape, situated in front of the lower extremity of the rectus, having its large extremity attached to the pubis, while its upper pointed extremity terminates by a slender aponeurotic slip which is lost upon the linea alba, between the pubis and the umbilicus. It is contained in a strong sheath, the anterior portion of which is formed by the aponueroses of the external oblique; the posterior, by those of the internal oblique and transversalis, which pass between it and the rectus. (See *Muscles.*)

From the arrangement of the abdominal muscles which has already been described, it will be seen that there is a portion of the parietes of the cavity under consideration, comprised between the upper part of Poupart's ligament and the lower margin of the internal oblique and transversalis, which is not closed up by those muscles. To supply this deficiency, we find a broad expansion, partly aponeurotic in its character, to which Sir Astley Cooper, to whom we are indebted for the first satisfactory description of it, applied the appellation of *fascia transversalis* (*Loc. cit.*), and which Hesselbach has designated *ligamentum inguinale internum.* (*De Ortu et Progressu Herniarum*, p. 10, plates 3 and 4.) It is attached inferiorly to the whole extent of the posterior and superior margin of Poupart's ligament, where it is continuous with the *fascia iliaca* presently to be described; internally, to *Gimbernat's ligament* and the edge of the tendon of the rectus muscle; externally, to the internal border of the crista of the ilium. From these points, it mounts upwards, in form of a broad expansion, partly aponeurotic and partly cellular; ascends between the transversalis muscle and the peritonæum, becoming more attenuated and delicate towards its upper part,—lining the whole extent of the anterior parietes of the abdomen, from whence it is reflected upon the concave face of the diaphragm, and sending prolongations through that muscle upon the vena cava, the œsophagus, and the aorta. The first of these prolongations finally becomes continuous with the fibrous tunic of the pericardium. It is only the inferior portion of this fascia which presents a fibrous or aponeurotic character; an arrangement which is highly important in fortifying the corresponding portion of the walls of the abdomen.

As the fascia transversalis mounts upwards from Poupart's ligament, it seems to divide into an internal and an external portion, which are so disposed as to form a small triangular, or oval, aperture, which is situated about twelve or fifteen lines above the central portion of Poupart's ligament. This opening, similar in its arrangement to that which has been described in the tendon of the external oblique, is denominated the *internal abdominal ring*. It transmits the spermatic chord in the male, and the round ligament of the uterus in the female. It also constitutes the point of division between the internal and external portions of the fascia transversalis just adverted to. The first of these, attached to the crista of the pubis, to *Gimbernat's ligament*, and to that part of *Poupart's ligament* which forms the outer pillar of the external abdominal ring, ascends in a perpendicular direction,

having its fibres ranging parallel with the rectus muscle. This is strong and resistant in the vicinity of the internal ring, and presents a firm crescentic margin, which constitutes the inner boundary of that opening. The second portion, less strong, attached to the outer or iliac portion of *Poupart's ligament*, and to the inner border of the crista of the ilium, mounts obliquely upwards and inwards towards the umbilicus, and thus decussating with the first, forms the triangular opening described above. (Velpeau, *Anatomie Chirurgicale.* Tom. II. p. 75. Paris, 1826.) It should be remarked, however, that the part called the internal abdominal ring is not a perfect opening, but rather the expanded extremity of a kind of infundibuliform canal, formed by a portion of the fascia descending from the contour of the opening in question upon the chord, which it surrounds in form of a sheath, and becomes lost in the cellular tissue occupying the external surface of the tunica vaginalis of the testicle. This elongated portion of the fascia is carried down before the testicle in its descent, and can be easily demonstrated by pulling the chord downwards before the connexions of the fascia have been cut, or by inflating it with air. It is particularly manifest where the parts have become thickened by the influence of an inguinal hernia, or by the protracted irritation kept up by a varicose state of the vessels of the chord. (Cloquet, *Op. Cit.* p. 27). It is in the course of this sheath, and between it and the vessels of the chord, that the parts protrude in the *external* or *oblique inguinal hernia:* and it consequently forms one of the tunics of the sac which have to be divided in the operation for that disease.

The internal abdominal ring, thus formed, is an elongated, triangular, or oval aperture, having its greater extremity directed downwards. The fascia which forms its inferior and internal boundaries is frequently strong and fibrous in its character; the external boundary is less resistant; and above, the fascia is very thin and feeble, but the opening is fortified in this direction by the inferior border of the internal oblique muscle.

Several portions of fascia have been described by different Anatomists under the appellation of *fascia propria*, but only a few have represented it as a continuous structure lining the whole extent of the cavity of the abdomen. In this latter respect it was very accurately described by Riolanus (*Anthropographia*, p. 153), Verheyn (*Corpor. Human. Anatomia, Cap.* 7, p. 83), Mauchart (*De Hernia incarcerata in Halleri Disputat. Chir. Lib.* III. p. 80), Diemerbroeck (*Anatome Corporis Humani*, p. 16), and several of the older anatomists, who considered it as the external tunic of the peritonæum. The same view of the subject has been taken in modern times by Langenbeck. (*Commentarius de Structura Peritonæi et Decensu Testiculorum*, p. 37.)

The *fascia propria* is merely a thin delicate expansion, composed of cellular tissue, situated between the fascia transversalis and the peritonæum. In its general arrangement, and the extent of its distribution, it corresponds with the fascia just described; like it, lining the whole of the internal parietes of the abdomen, and sending out prolongations or sheaths upon the vessels and other parts which enter that cavity, or make their escape from it. The only portion of the *fascia propria* with which we are at present particularly interested, is that which lines the anterior and inferior walls of the abdomen, in the vicinity of Poupart's ligament. It is here observed ascending from the ligament just mentioned, between the fascia transversalis and the peritonæum, with both of which it is connected by loose cellular tissue, but may be separated from them in form of a thin continuous membrane. At the *internal abdominal ring*, like the fascia transversalis, it sends off an infundibuliform process, which descends upon the chord in form of a sheath, and becomes lost above the testicle. The fascia propria, though remarkably thin and delicate in its natural state, is frequently so much thickened under the influence of disease, as to become almost aponeurotic in its character.

The space comprised between the external and the internal abdominal ring, is denominated the *Inguinal Canal.* It is occupied, throughout its whole extent, by the spermatic chord in the male, and the round ligament of the uterus in the female. It ranges in an oblique direction downwards and inwards, and under ordinary circumstances measures about an inch and a half in length. The inferior boundary is formed by the upper grooved surface of *Poupart's ligament*, upon which the chord reposes; posteriorly, it is bounded by the *fascia transversalis*, which, as has been already stated, is attached to the posterior margin of the ligament just mentioned; and anteriorly, by the tendon of the external oblique muscle. Its inferior termination is the *external abdominal ring*, while its superior limit is the point at which the spermatic chord perforates the fascia trans-

versalis. That portion of the chord, therefore, which is lodged within the canal in question, is surrounded, throughout its entire extent, by the infundibuliform sheath furnished by the fascia propria and fascia transversalis, which has already been described. The oblique direction pursued by the spermatic chord, in its escape from the cavity of the abdomen, was long since noticed by Riolanus (*Anthropographia*, p. 141.), Camper (*Icones Herniarum*), and Albinus; but the arrangement of the inguinal canal, and its importance in diminishing the liability to hernial protrusions, were not properly understood until they were explained by Sir Astley Cooper. He has very correctly observed, that were it not for the obliquity of this passage, few persons would be exempt from accidents of the kind just adverted to. (*The Anatomy and Surgical Treatment of Hernia*, p. 7.)

The inguinal canal does not exist in the child at birth, but the spermatic chord passes directly forwards, from the abdominal cavity, to escape through the external abdominal ring. In proportion, however, as the innominatum becomes expanded by a more perfect development, and the muscles are put more upon the stretch by the increased volume of the abdominal organs, the internal ring is gradually inclined outwards, and continues to advance in that direction until the parts have attained their full development. (Allan Burns, *Edinburgh Med. & Surg. Journal*, II. Scarpa, *Memorie Sull' Ernie*, p. 7.) This circumstance would render young children very liable to hernial protrusions, were it not that they are not exposed to the violent bodily efforts which constitute so frequent an exciting cause of that disease in adults.

It sometimes happens that the testicle, in its descent, is arrested in the inguinal canal, and being under such circumstances concealed, it might be inferred that there was an absence of that gland. Hernial protrusions are also sometimes arrested in the same situation, and may become strangulated without any suspicion of the nature of the accident being excited.

The *Epigastric artery*, in consequence of its important relations with the internal abdominal ring, deserves to be attentively considered. It comes off from the external iliac artery where it is about to pass under Poupart's ligament, sometimes a little lower down, and from thence mounts upwards and inwards along the inner margin of the internal abdominal ring, and finally reaches the sheath of the rectus muscle, which it penetrates, and sends off numerous small branches which anastomose with the internal mammary and the ramifications of the lumbar arteries. Throughout the whole of its course, until it perforates the sheath of the rectus, it is situated between the fascia transversalis and the peritonæum, and is included in a duplicature of the fascia propria. When it is coursing along the inner margin of the internal ring, it forms a curve, the concavity of which is directed upwards and outwards, over which the vessels of the chord are inflected, and have the appearance of being sustained by it, though in reality they are principally supported by the fascia transversalis. On a level with the internal abdominal ring, the epigastric artery gives off one or more small ramifications, which descend upon the chord to supply the cremaster muscle and the sheath of the spermatic vessels. Higher up, it sends off a horizontal branch, of variable size, which runs inwards towards the pubis, to anastomose with the ramifications of a similar branch from the opposite side, and with others from the obturator. This vessel is frequently situated upon the upper surface of Gimbernat's ligament, and under such circumstances might be divided in dilating the stricture inwards in femoral hernia.

Sometimes the epigastric artery is given off by a trunk which is common to it and the obturator; and it occasionally happens that a second anomalous epigastric is sent off by the external iliac, which ascends along the external margin of the inner abdominal ring, so that that opening will be included between two vessels. (Meckel, *Manual of Anatomy*. II. 323. Philadelphia, 1832.)

The whole extent of the anterior and lateral parietes of the abdomen are lined by a thin transparent serous membrane denominated *Peritonæum*, which is besides reflected over the several organs contained within this cavity. The fossæ and duplicature, formed by that portion of this membrane which lines the anterior walls of the abdomen, have been already described, and it only remains to consider its general properties, and the nature of its connexions with the surrounding parts.

Though this membrane everywhere exhibits a thin and diaphanous character, it is much thicker and stronger at some points than at others. In the vicinity of the ensiform cartilage, and along the superior portion of the linea alba, where the walls of the abdomen are fortified by the strong tendons of the transversalis and internal oblique muscles, the peritonæum is thinner than in any other situation. It however adheres very intimately to those tendons. Below the umbilicus, and in the

vicinity of the lower part of the recti muscles, where the posterior portion of their sheath is deficient, it becomes much stronger. It is also more compact and resistant towards the inferior portion of the abdomen, in the neighbourhood of the inguinal canal, and in the lumbar region. In some situations, indeed, it is so thick and strong as to present a whitish opaque appearance. But notwithstanding the extreme tenuity of the peritonæum, it possesses very considerable powers of resistance. It is stated by Scarpa, (*Memorie sull' Ernie*, p. 8.) that a section of it isolated from its attachments, and stretched over a small hoop, was capable of sustaining a weight of fifteen pounds without being ruptured; and after the weight was removed, it gradually returned to the condition which it presented before the distending force was applied. This faculty is also manifested in the great distension of the peritonæum which takes place in large hernial protrusions, in abdominal dropsies, in pregnancy, and in the development of large tumours, in which it is submitted to an inordinate state of extension without giving way.

The internal surface of the peritonæum is free throughout its whole extent, and exhibits a smooth and polished aspect. The external is adherent, and is united to the *fascia propria*, or, if the existence of that structure as a membrane be denied, to the fascia transversalis, by means of cellular tissue, which in most situations is loose, delicate, and highly extensible, but at some points is compact and resistant. In the course of Poupart's ligament, the attachment between these parts is very firm, as is also the case upon the upper part of the pubis, the posterior face of the aponeurosis of the abdominal muscles in the vicinity of the umbilicus, in the course of the umbilical ligaments, and about the contour of the internal abdominal ring. In the lumbar and iliac regions, on the contrary, its connexions are so exceedingly feeble, that the loose meshes of cellular tissue by which they are accomplished become readily elongated, when any force is applied, so as to allow the peritonæum to glide, as it were, with facility upon the parts which are situated beneath. It is in virtue of this arrangement that that membrane is drawn downwards in the descent of the testicle, so as to be carried into the scrotum, to form the tunica vaginalis,—that it is forced downwards before a hernial protrusion to form an investing sac, and that it is submitted to a variety of displacements of a similar kind. All these effects are aided, however, by the great extensibility of the membrane itself. When the meshes of the connecting cellular tissue become elongated by this process, a change is generally developed in the nutritive acts of the parts by a process of inflammation, by which these meshes are rendered thicker and more compact, and thus contribute to augment the thickness and density of a hernial sac. (Jules Cloquet, *Recherches Anatomiques sur les Hernies*, p. 44.)

At the point at which the spermatic vessels engage themselves in the inguinal canal, a process of the peritonæum descends through that passage upon those vessels, to the bottom of the scrotum, to form the *tunica vaginalis testis*. This arrangement does not exist in the fœtus previously to the descent of the testicle, but results from the process of the membrane in question being carried down by that gland, as it passes from the cavity of the abdomen into the scrotum. At the period this descent takes place, the portion of the peritonæum which is carried down represents an elongated purse, the opening of which is situated at the internal abdominal ring, while its bottom is lodged in the scrotum, and is reflected upon the anterior surface of the testicle. There being, therefore, a free communication between the cavity of the abdomen and the scrotum, through this purse-like prolongation, some one of the abdominal organs may protrude in the course of this passage, and give rise to the disease called *congenital hernia;* or a serous fluid may pass from the one cavity into the other, occasioning the condition denominated *congenital hydrocele.* In most cases, however, shortly after the testicle has descended, a process of adhesive inflammation is developed in that portion of the membrane which is spread out upon the surface of the spermatic vessels, by which the whole extent of the corresponding portion of the membranous canal is obliterated, and firmly united with the vessels just mentioned. In this manner all communication between the cavity of the abdomen and that portion of the peritonæum which forms the tunica vaginalis is cut off, and no protrusion can take place from the one to the other, except by carrying before it a new portion of the membrane. It sometimes happens, however, that no such obliteration takes place, and under these circumstances a hernial protrusion may occur at any period of life, presenting all the characters of the congenital form of the disease.

In the female, a similar prolongation of the peritonæum descends, through the in-

guinal canal, upon the round ligament of the uterus. It presents a difference of arrangement in different subjects—sometimes it merely forms an elongated band of a solid consistence; but more frequently it is tubular, and forms what is denominated the canal of Nuck. Under these latter circumstances the tube is occasionally so small as merely to admit a probe, but in some instances it will receive the point of the finger. It may either present a simple cylindrical tube, terminating in a blind extremity, or a kind of pouch communicating with the cavity of the abdomen by a small contracted orifice. (Cloquet, *loc. cit.* p. 41, plate 4, fig. 5.) In either case, it may form the rudiment of a hernial sac, which, by the distending force of the protruding organ, may be carried through the external ring into the groin, or the labia pudendi.

From what has been said it will be seen, that there are three points at which the abdominal organs may be protruded through the anterior inferior walls of that cavity: 1, at the internal abdominal ring, and from thence through the inguinal canal and the external ring into the groin or scrotum; 2, in the middle peritonæal fossa, between the epigastric artery and the umbilical ligament, and from thence directly forwards through the external abdominal ring; and 3, in the internal peritonæal fossa, between the umbilical ligament and the external margin of the tendon of the rectus muscle. This variety also escapes through the external abdominal ring. The first, which is the most frequent, is denominated *external*, or *oblique inguinal hernia.* The second and the third constitute what are called *direct*, *internal*, or *ventro-inguinal hernia.* The third variety is of rare occurrence: the second takes place more frequently. (*See* Hernia.)

The manner in which the aponeurotic expansions of the external and internal oblique, and the transversalis muscles, unite with each other, upon the median line of the abdomen, by an intimate interlacement of their fibres, has been already described. In this manner is formed a whitish colored, compact, resistant raphe, which extends from the ensiform cartilage of the sternum to the pubis, denominated *linea alba.* This raphe, or band, is perforated a little below its middle by a rounded opening called the umbilicus, which in the fœtus transmits the umbilical chord composed of two arteries and a vein, and their investing structures; but which after birth becomes consolidated and closed up, by a firm, compact, unyielding cicatrix. At this point the *linea alba* is about half an inch in breadth, but as it descends towards the pubis it becomes much narrower, and at the same time acquires more strength. Between the umbilicus and the sternum it is wider than it is below that opening, and generally measures from two to four lines. In this latter region, however, the aponeuroses of the abdominal muscles, being thinner than they are below, the *linea alba* is less strongly fortified, and presents numerous small interstices between its fibres, filled up by small pellets of fat, or a number of small apertures for the transmission of small blood-vessels. These openings are most numerous in the immediate vicinity of the umbilicus and the ensiform cartilage, and they may, in some individuals, become so much enlarged by the inordinate distension of the parietes of the abdomen, as to give rise to hernial protrusions in the course of the *linea alba.* These protrusions may, indeed, take place either below or above the umbilicus, but are by far more frequent in the latter situation, especially in the immediate vicinity of that opening, in which case they have frequently been mistaken for an umbilical hernia. Such protrusions may consist of either omentum, intestine, or a portion of the stomach, and when they occur in the fœtus, while the liver occupies a large proportion of the abdominal cavity, even a portion of that organ, or the spleen, may occupy the tumour. (*Memorie sull' Ernie*, p. 139.) Such accidents are most apt to occur in females who have had many children, the repeated and long-continued distension of the abdomen having a tendency to attenuate the aponeuroses to such a degree as to dispose them to yield more readily to any protruding force. When such a condition exists, two or more tumours may be developed in the course of the *linea alba* (Monteggia, *Instit. Chirurg.* Part 3, § 659), and should the organ become constricted, all the symptoms of strangulated hernia will ensue. (Maunoir, *Journal Générale de Médecine.* Tom. XX.)

It moreover sometimes happens, that these small openings become occupied by the pellets of fat which are situated between that duplicature of the peritonæum which enters into the formation of the umbilical ligament, and the posterior face of the *linea alba.* Examples of this kind were long since reported by Morgagni (*De Sedibus et Caus. Morb. Epist.* 43, 10. *Epist.* 50, 24.), and Klinkosch (*Dissert. Med. Select.*, p. 189), and although the possibility of their occurrence was doubted by Petit (Scarpa, p. 145), subsequent observations

have established the fact beyond all possibility of dispute. These tumours may be considered as constituting small *adipose hernias* of the linea alba, the number and magnitude of which will vary under different circumstances. Scarpa reports the case of an old emaciated man in whom two of these tumours existed. One of them, about the size of a common nut, was situated immediately below the ensiform cartilage; the other, as large as a pigeon's egg, was placed about two inches above the umbilicus. These tumours are generally pediculated, and impart a sensation to the touch similar to that which is communicated by an omental hernia. Indeed, where symptoms of strangulation exist, they may be mistaken for a protrusion of some one of the abdominal organs, and lead to the performance of the operation, as happened in one instance to the author just referred to. (Scarpa, *Op. Cit.* p. 146.)

The portion of this region, however, which has most engaged the attention of anatomists and surgeons, is the umbilical opening itself. This differs very materially in the fœtus, and in the individual after birth; and we observe a corresponding difference in the comparative liability to umbilical hernia at these two periods of life. In the fœtus, it has been already stated, that the aponeuroses of the abdominal muscles are perforated by the vessels of the chord; and that they may not be compressed, the opening by which they are transmitted is necessarily large, and is bounded by a thin and yielding margin. In addition to this, the skin of the abdomen passes for some distance upon the vessels of the chord, with which it is merely connected at that early period of life by a delicate cellular tissue almost gelatinous in its character. The arrangement of the parts is, therefore, such as to possess very feeble powers of resistance; and it accordingly happens, that when any exciting cause is brought into operation, an umbilical hernia will be very readily developed. The manner in which this takes place is usually the following: the two umbilical arteries, ascending as they do from the fundus of the bladder to the opening under consideration, come in relation, in this latter situation, with the umbilical vein, which, as it mounts upwards towards the liver, leaves between it and the arteries a small triangular depression in which the protrusion first commences. In proportion, however, as the process advances, the delicate connecting medium between the vessels themselves, or between them and the chord, is gradually broken up, the organ escapes from the cavity of the abdomen, and a tumor of variable magnitude, according to the circumstances of the case, is developed in the course of the umbilical chord. This form of the disease is usually congenital in its character, and seldom takes place after birth, especially after the umbilical chord has had time to become fully cicatrized. It should be stated, however, that a *congenital umbilical hernia* may be developed by a process very different from this. The parietes of the abdomen, as well as the other parts of the body, are formed from the circumference towards the centre, and there is consequently a period in their development at which all the organs of that cavity are naked or exposed, inasmuch as they only become covered when the two lateral portions of its walls approximate and unite upon the median line. As, therefore, the intestines are developed by the omphalo-mesenteric vessels, which penetrate the abdomen at that point which subsequently constitutes the umbilicus, should the regular evolution of the walls of the abdomen be retarded or interrupted, while that of the intestines continues, it will frequently happen that a portion of this intestine may remain without the abdominal cavity, the umbilical opening being imperfectly closed, and thus give rise to a congenital hernia of the kind under consideration. Indeed, in some instances, a complete arrest of the process of development takes place, and leaves the anterior walls of the abdomen deficient, with its organs perfectly naked and exposed. That this explanation is correct may be demonstrated by the fact, that such examples of *umbilical hernia* are generally accompanied with some other pathological condition, which is also dependent upon some disturbance or interruption of the formative powers: as *spina bifida*, *acephalia*, *exstrophia* of the *bladder*, &c. (Meckel, *Handbuch der Pathologischen Anatomie* Band I. Idem, *De Monstrorum Nonnullorum*, 1826.) Such cases of umbilical hernia occasionally make their appearance at a very early period of utero gestation, cases having been observed even in the early months. (Scarpa, *Loc. Cit.* Velpeau, *Anatomie Chirurgicale*, Tom. II. Blandin, *Anatomie Topographique.*)

After birth, when the umbilicus has had time to become completely cicatrized, the state of the opening becomes entirely changed. The vessels are obliterated and retract, the skin which is spread out upon the chord also retracts and draws the divided vessels inwards; the delicate connecting medium by which all these parts

are united becomes consolidated, and the whole are finally converted into a compact, unyielding cicatrix, almost ligamentous in its structure. Under these circumstances, a hernial protrusion between the umbilical arteries and the vein will be no longer practicable; it can seldom take place between the rudiments of those vessels and the contour of the ring; and it consequently follows, that a large majority of those cases which have been described as examples of umbilical hernia, have in reality merely consisted of protrusions taking place by the side, and in the vicinity, of the umbilical ring.

From the very intimate adhesion between the peritonæum and the posterior part of the sheath of the recti muscles, it has been questioned by many very distinguished surgeons, if the protruded organs in an umbilical hernia are furnished with any covering from that membrane. They have indeed conceived, that this connexion is so compact that it cannot yield to the protruding force by which the organ is expelled from its cavity, and consequently, that the peritonæum must necessarily be ruptured, and suffers the parts to protrude through the opening thus formed, or that it is speedily absorbed. Such was the opinion advanced by Méry (*Mémoires de l'Académie Royale des Sciences*, 1716), Dionis, Garengeot, Richter (*Anfangsgrunde der Wundarzneikunst.* Band V.), and others; but Barbette (Mangetus, *Opera Omnia*, Tom. II., p. 74,) long since affirmed, that in a case of umbilical hernia, in which the tumour was as large as the head of an adult, the peritonæal sac was found entire. In modern times, it has been affirmed by Scarpa (*Op. Cit.* p. 141), that this is always the case, and this seems to be the general opinion of the best pathologists of the present day.

The coverings of an umbilical hernia are generally very thin, and in very young children are frequently almost transparent. The tumour, in consequence of the resistance occasioned by the common integuments, is usually broad and flattened at its fundus, while its neck represents a small pedicle. It is merely covered by the skin and subcutaneous cellular tissue, the fascia superficialis, which is very thin, by the cellular tissue which connects the peritonæum to the sheath of the rectus muscle, and by that membrane itself. The fascia transversalis and fascia propria scarcely present a membranous character in the course of the linea alba. All these coverings being, therefore, very thin, great caution must be observed in opening the sac, lest the organs should be wounded. In attempting to reduce an umbilical hernia by taxis, the force should of course be carried directly backwards, inasmuch as the aperture by which the organs escape, in this form of the disease, merely represents a simple ring, and not a tortuous canal as in inguinal and crural hernia.

The Posterior Walls of the Abdomen.—The external and internal configuration of the posterior walls of the abdomen have been already described. It is divided into two lateral portions, which are symmetrical, by the perpendicular prominence formed by the projecting bodies of the lumbar vertebra. On each side of this prominence is an elongated excavation which extends from the diaphragm to Poupart's ligament; and at the latter point the posterior and anterior walls unite with each other at an acute angle. Entering into the formation of the posterior wall, we have the skin and subjacent cellular tissue, the muscles which are attached to the posterior portion of the spine, the lumbar portion of the spinal column, with its connecting ligaments and intervertebral substance, the quadratus lumbarum, psoas magnus and parvus, and iliacus internus muscles, the fascia iliaca, fascia propria, peritonæum, and numerous vessels and nerves. It will be unnecessary to describe all these parts individually, as they will be considered under their appropriate heads. We shall therefore confine our observations to those parts which are situated within the cavity, and which are placed in front and by the side of the osseous structures already adverted to.

The peritonæum and fascia propria, throughout the whole extent of this region, are merely connected to the parts which are situated beneath them, by means of cellular tissue, which is exceedingly loose in its arrangement. This explains the facility with which the former membrane is drawn downwards, when any one of the abdominal organs protrudes from the cavity. The manner in which this takes place has been already explained. It is also through the loose meshes of this cellular tissue that the matter of a *lumbar* or *psoas abscess* travels, to point at the groin, thus finding an easy route behind the peritonæum, from the point of its first development, to the situation at which it manifests itself beneath Poupart's ligament. The peritonæum, in this region, does not adhere in a uniform manner to the walls of the cavity which it lines, as it does to the anterior parietes of the abdomen, but is reflected over the surface of

the different organs to furnish most of them with a covering, and maintain them in their situation.

When all the organs have been removed, the region under consideration presents an inclined plane, extending from the diaphragm to Poupart's ligament, and bounded externally by the crista of the ilium; internally by the prominence occasioned by the lumbar vertebræ, and by the brim of the pelvis. This inclined plane, by uniting at Poupart's ligament with a similar surface presented by the anterior wall of the abdomen, forms an arrangement which has been compared to the expanded portion of a funnel deficient on the side towards the pelvis, the neck of which descends behind Poupart's ligament, to form an opening, or canal, which we shall presently describe under the appellation of *crural canal*, or *crural ring*.

Poupart's ligament, which, as has been stated, forms the inferior termination of these two inclined planes, as it passes from the spine of the ilium to the pubis, leaves between it and the horizontal portion of the bone an irregular elongated opening, which is partly filled up by muscles, vessels, and nerves, and partly by an arrangement of fascia, which must now be described. This opening is somewhat narrower about its middle than at its two extremities, in consequence of the pectinæal prominence of the bone, and may be compared to a figure of ∞ placed horizontally. The depression situated on the outside of the prominence, is nearly filled up by the united portions of the psoas magnus and iliacus internus muscles; that on the inner side, by the crural artery and vein, and the anterior crural nerve. On the inner side of the vein, however, and between it and *Gimbernat's ligament*, there is a small annular, or rather elliptic space, which is less completely closed, and which is described under the appellation of the *crural ring*. The arrangement of these parts will be more particularly examined, after we have described the fascia which lines the posterior wall of the abdomen.

The whole extent of the iliac and lumbar regions of the abdomen are lined by a fascia, which is strong and almost aponeurotic below, but more feeble in its structure above. It was first described by Sir Astley Cooper under the appellation of *iliac fascia*, but should be considered as merely a continuation of the *fascia transversalis* already described, of which it constitutes a portion. It reposes upon the quadratus lumborum, iliacus internus, and psoas muscles, to which it is connected by loose cellular tissue. It is attached externally to the internal border of the crista of the ilium, and internally, where it reposes upon the psoas muscles, it forms a sheath for the iliac vessels, contracts an intimate adhesion with the brim of the pelvis, and descends into that cavity to constitute the pelvic fascia. (See *Pelvis.*) Inferiorly, the *iliac fascia* is arranged differently on the outer and the inner side of the *crural vessels*. On the outer side of those vessels, it passes downwards upon the anterior face of the psoas and iliac muscles, and on a level with Poupart's ligament divides into two layers, one of which is posterior and inferior, the other anterior and superior. The first continues to descend upon the face of those muscles, to become continuous with the profound, or *pectinæal* portion of the *fascia lata* of the thigh, while the second is reflected forwards, to attach itself with the whole extent of Poupart's ligament, comprised between the crural vessels and the anterior superior spinous process of the ilium, and then to become continuous with the *fascia transversalis*. In the angle formed by the separation of these two layers of fascia is lodged the *circumflex iliac artery*. (Manec, *Sur la Hernie Crurale*, p. 21, plate 2. Paris, 1826.) In consequence of this arrangement, that portion of the space behind Poupart's ligament, and between the crural vessels and the spine of the ilium, is so effectually closed up as to render a hernial protrusion in that situation impossible, or at least exceedingly rare.

At the extreme inner part of this region, the *fascia iliaca* adheres to the pubis and the superior surface of *Gimbernat's ligament*. On the outer side of this ligament, and from that point to the external limit of the crural vessels, it adheres to the *horizontal ramus* of the *pubis*, and, fortified by the expanded tendon of the psoas minor muscle, descends behind the vessels, and becomes continuous with the *profound layer* of the *fascia lata* of the groin, as already stated in reference to the external portion. It therefore forms the posterior boundary of the *crural ring*, and the posterior portion of the *sheath of the vessels*, while the anterior is formed by the *fascia transversalis* descending in a similar manner behind Poupart's ligament, and in front of the same vessels, to become continuous with the superficial portion of the fascia lata. This disposition of the two fascia furnishes the neck, or stem, of the funnel-like arrangement to which we have adverted above, and is instrumental in the development of two parts which are highly

important in relation to the subject of *crural* or *femoral hernia;* the first, the *crural canal*, consisting of the sheath of the vessels, and the second the *crural ring*, comprising the space situated between the inner part of the *crural vein* and the external margin of *Gimbernat's ligament.* (Manec, *Op. Cit.*) These two parts, generally confounded with each other, should be considered apart: but to enable us to form a correct understanding of their arrangement, it will be necessary to examine first the Fascia Lata of the groin.

This is a strong fibrous aponeurosis, which invests the whole of the muscles of the thigh, and connects itself above, on the one hand, with *Poupart's ligament*, and on the other, continues with the *fascia transversalis* and *fascia iliaca*, as just described. It does not belong to the abdomen, but its intimate connexion with parts which we have been considering, renders it necessary to take some notice of it in this place.

In the upper portion of the groin, and about an inch below Poupart's ligament, the fascia lata seems to be perforated by a large rounded opening for the transmission of the internal *saphena vein*, where it is about to unite with the *femoral vein.* This appearance, however, results from the division of the fascia into an internal and an external portion, which separating from each other, the first to mount upwards behind the crural vessels, the second in front of them, give rise to an opening, the inferior boundary of which presents a thick well defined concave border, looking upwards, through which the *saphena vein*, which is superficial, dips down to discharge itself into the *femoral vein*, which is situated beneath the fascia. That portion of the *fascia lata* which is situated on the outer side of the vein, sometimes denominated superficial, or iliac portion, mounts upwards to unite itself to the whole extent of *Poupart's ligament*, from the spine of the ilium to the pubis, and to become continuous with the *fascia transversalis*, which, as has been stated above, descends behind the ligament just mentioned, to connect itself with the fascia of the groin. Its internal border, however, instead of ascending in a perpendicular direction, takes a course upwards and inwards, in front of the crural vessels, and by describing a kind of semicircular sweep as it ascends, its internal margin forms a *crescentic* or *falciform border*, the concavity of which is directed inwards and slightly downwards, while the extremity of this border ascends behind the extreme inner part of Poupart's ligament, to blend itself with the inferior face of *Gimbernat's ligament*, which it assists in forming. This arrangement was first noticed by Hey, and it constitutes a portion of what has since been sometimes described under the appellation of *Hey's ligament.* It was denominated, by Allan Burns, the *falciform process of the fascia lata.* It forms the anterior portion of the *sheath of the vessels*, or the *crural canal.*

The *internal*, *pubic*, or *pectinæal portion* of the *fascia lata*, from the internal portion of the *saphena vein*, mounts upwards in front of the pectinalis muscles, and behind the crural vessels, at the same time inclining outwards, that while it gets behind the vessels, it ascends upon the anterior face of the *psoas* and *iliac muscles.* Pursuing this course, it finally reaches the level of the *horizontal ramus* of the *pubis*, with which it adheres intimately behind the vessels and on a level with the posterior boundary of the crural ring, and finally becomes continuous with the inferior and posterior layer of the *iliac fascia*, as already described. It consequently forms the posterior portion of the *crural sheath*, or *canal.*

The crural canal is that portion of the sheath of the crural vessels comprised between the point at which they engage themselves behind Poupart's ligament and the lunated opening of the fascia lata, which is traversed by the saphena vein. This canal has been confounded by Sir Astley Cooper, Cloquet, and most writers on the subject, with the *crural ring*, from which, however, it is altogether distinct, as has been very correctly represented by Manec. The crural vessels and the anterior crural nerve, as they descend from the cavity of the abdomen into the groin, are placed in the following order: the nerve is on the outer side, the artery is situated next to it, and the vein is placed on the inner side of the artery. It has been already stated, that on the outer side of these parts, the direct continuity of the *fascia iliaca* with the *fascia transversalis* completely closes up the space between Poupart's ligament and the bone, so as to render it impossible for any protrusion to take place in that situation, at any point between the artery and the spine of the ilium. Where the vessels escape from the abdomen, however, the arrangement of the parts is different: the *fascia iliaca* descends behind them to continue with the profound layer of the *fascia lata*, while the *fascia transversalis* descends in front to continue with the superficial layer of

the same *fascia* and its *falciform process.* These vessels, therefore, seem to be placed between these two layers of fascia in the same manner as though they were laid between two sheets of paper. If, however, the superficial layer be slightly elevated, by pinching it in the forceps, it will be observed that several small septa, or partitions, pass backwards, from the superficial to the deep-seated layer of the fascia lata, the most exterior of which constitutes the external boundary of the nerve, the second forming a partition between the nerve and the artery, the third separating the latter vessel from the vein, while the fourth, which is the strongest of all, passes from the edge of the falciform process backwards, bounding the vein internally, and separating it at the same time from the *crural ring*, which is on its inner side. This latter portion generally reposes in contact with a mass of lymphatic glands, the vessels of which, by traversing it, give it something of a *cribriform* appearance. It constitutes the internal boundary of the *crural canal*, the external limit of which is formed by the connexion which is established between the superficial and deep-seated portions of the fascia on the outer side of the vessels and nerves. The superior opening of this canal corresponds with the point at which the vessels escape from the cavity of the abdomen, while the inferior is represented by the point at which the saphena vein perforates the fascia lata, to unite with the femoral vein. The canal, however, cannot be considered as terminating at this latter point by an open extremity, as described by Beclard and Cloquet, because the saphena vein is still contained within a sheath, which accompanies it throughout the whole extent of the thigh. The crural canal thus formed, may be considered as representing the stem, or neck, of the funnel-like arrangement above adverted to, while the expanded portion of the same is represented by the *fascia iliaca* and *fascia transversalis*, where they are spread out within the abdomen.

In consequence of the manner in which the sheath is fortified by the numerous perpendicular partitions which traverse it from before backwards, and their intimate adhesions with the vessels, it will be impossible for any protrusion to take place through it; at least such an accident, if it ever does take place, must be of very rare occurrence, though it has been conceived by Beclard and Cloquet, that an organ, escaping through this passage, might become strangulated at the point which they have denominated the *inferior opening of the crural canal.*

The *crural ring*, properly so called, is a small triangular, or rather oval opening, having its largest extremity directed outwards, situated between the crural vein and the external concave margin of *Gimbernat's ligament.* It is larger in the female than in the male, but its dimensions vary very materially even in individuals of the same sex. On an average, its transverse diameter, which is the largest, is from six to ten lines, though where the pelvis is very much developed, it may measure an inch. Internally, the *crural ring* is bounded by the sharp, crescentic border of *Gimbernat's ligament* already described; anteriorly, by *Poupart's ligament* and the tip of the *falciform process* of the *fascia lata*, which, where it is strongly developed, forms a kind of imperfect anterior wall; externally, by the *septum* which constitutes the inner boundary of the *crural canal;* and posteriorly, by the *crest* of the *pubis.* In some cases Gimbernat's ligament is less distinctly marked than usual, and in such instances the transverse diameter of the *crural ring* is alwavs increased in the same ratio.

This opening, which constitutes the point at which the organs protrude in crural hernia, is generally partially filled up by one or more lymphatic glands, and more or less loose cellular tissue; but in addition to this, it is fortified by a kind of *fibro-membranous septum*, perforated by numerous minute orifices, which was described by Sir Astley Cooper under the appellation of *cribriform fascia*, and which Cloquet has denominated *crural septum.*

This septum, which is strong and resistant, is placed in nearly a horizontal direction, when the individual is erect, and completely closes up the crural ring, to the whole contour of which it is attached. Internally, it is intimately connected with the crescentic margin of Gimbernat's ligament, and externally, to the inner portion of the sheath of the crural vessels. Its superior face, which is directed towards the cavity of the abdomen, and which is lined by the peritonæum, is slightly concave; the inferior, which is inclined downwards, is convex. Where it is strongly developed, it seems to be composed of transverse fibres, but in many cases it is altogether of a cellular structure. In all cases, it is perforated by numerous small apertures, which are traversed by the lymphatic vessels, and sometimes one or more of these small openings are occupied by a minute gland. (Cloquet, *Op. Cit.* p. 73.)

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When the finger is forced from the cavity of the abdomen downwards, into the crural ring, it meets with considerable resistance, occasioned by this septum; and in consequence of the manner in which it closes up the opening, it constitutes the principal obstacle to a hernial protrusion. It sometimes happens, nevertheless, that one of the small openings mentioned above becomes sufficiently dilated or ruptured to allow a portion of intestine or omentum to escape, or the septum itself is extended, and carried before the protruding organ, so as to allow the same accident to take place. (See *Hernia.*)

The most important vessel situated in the vicinity of the crural ring is the *obturator artery*. This vessel, which most usually comes off from the internal iliac, and passes from thence to the upper part of the thigh through the obturator foramen, not unfrequently departs from this arrangement, and takes its origin from the external iliac, or the crural, either separately or by a common trunk with the epigastric. This anomalous disposition was long since noticed by Haller and some of the older anatomists, and has, in modern times, been very attentively investigated, in consequence of the intimate relations of the vessel with the parts concerned in a crural hernia. Haller speaks of nine cases in which this anomalous distribution was observed. (*Icones, Anat. fasc.* 4. Nota 9.) Hesselbach met with three examples, in 32 bodies, in which the obturator artery was given off by the external iliac. (*Ueber den Ursprung und Verlauf der unteren Bauchdecken-Schlagader.* 1819. 1. *Abbild.*) Monro has represented the comparative frequency of the anomalous origin of the obturator artery as 1 in 20; (*Morbid Anatomy of the Stomach and Gullet*, p. 125. Edinburgh, 1830.) and this accords with the result of the experience of Velpeau. (*Anatomie Chirurgicale*, Tom. II. p. 159.) Burns observed it in 30 cases. Lawrence and Scarpa estimate the frequency of its occurrence at 1 in 10 or 12 bodies. Out of 250 subjects, one half males, the other half females, examined by Cloquet, he found the obturator artery arising from the internal iliac, on both sides, in 160, of which 87 were males and 73 females: from the epigastric, on both sides, in 56, of which 21 were males and 35 females: from the internal iliac, on one side, and the epigastric, on the other, in 28; males 15, and females 13: from the crural, in 6; males 2, females 4. (*Recherches Anat. sur les Hernies.* 4to. p. 72.) It will thus be seen, that these anomalies in the origin of the obturator artery are more frequent in the female than in the male; an observation which has also been made by Tiedemann. (*Tabulæ Arteriarum Corporis Humani.* Tab. XXX. p. 295. Carlsruhæ, 1822.) Breschet (*Mémoire sur la Hernie Crurale.* Paris, 1819.) has estimated that the obturator takes its origin from the external iliac, the crural, or epigastric, in the ratio of 12 to 63; Manec, (*Recherches Anatomico-pathologiques sur la Hernie Crurale*, p. 27,) 1 in 6; and Meckel (*Manuel d'Anatomie*, Tom. II., p. 448) affirms, that if we take into account the cases in which the artery derives one branch from the internal iliac, and a second from some one of the vessels designated, the anomaly occurs almost as frequently as the natural arrangement, inasmuch as this disposition generally exists during the early months, and only becomes modified by one of these branches becoming obliterated. Consequently, that one which remains pervious will represent the obturator, whether it come from the internal or external iliac. The result of our own observations upon this point would lead us to adopt the conclusions of Cloquet, Breschet, and Manec, which are but slightly at variance with each other. Of course, we would not include the cases just adverted to, in which the vessel derives its origin from both sources.

All these anomalies are important, inasmuch as the relations of the obturator, when it takes its origin from the epigastric or the crural, are frequently so intimate with the anterior and internal portion of the protruded parts which are concerned in a crural hernia, as to expose it to the knife in operating for the relief of that disease. It has been observed, that when it comes off by a common trunk with the epigastric, and that common trunk is long; or where it arises from the crural, below Poupart's ligament, it generally twines round the internal portion of the neck of the hernial sac, and would of course be divided in dilating a stricture upwards and inwards, or directly inwards. But when the trunk of the epigastric is short, or the vessel comes off, high up, from the external iliac, it will always pass on the outer side and behind the hernial sac, and will consequently be out of the reach of the knife. This latter disposition of the artery is more frequently observed than the former, but the cases in which the obturator artery passes in front, and on the inner side of the sac, are by no means confined to the female sex as represented by Hesselbach. Lawrence supposed that in forty

cases in which the obturator artery takes its origin from the epigastric or the crural, it will not be found passing in front of the crural ring in more than one. Our own researches, however, would lead us to the adoption of a different estimate, and to represent the anterior distribution of the vessel as occurring much more frequently than is here represented. Out of eight examples of the anomalous origin of the obturator contained in the museum of the University of Maryland, which we have just examined, the artery passes in front of the crural ring in three; behind, in four; and in one, it seems to pass directly across it in a transverse direction.

In addition to the vessels enumerated, the spermatic artery should also be mentioned, amongst those which are situated in the vicinity of the crural ring. It descends with the spermatic chord in an oblique direction along the course of the inguinal canal, and in the vicinity of the external abdominal ring, and is consequently situated immediately in front of the crural opening. In attempting, therefore, to dilate the stricture in crural hernia, by cutting directly upwards, this vessel might be divided, as happened to Arnaud, Hey, Scarpa, and others.

The veins follow, for the most part, the course of the arteries, and are sometimes double. Occasionally, however, they depart from the natural order of their distribution, and assume new relations which it is important to note. When the obturator artery arises from the external iliac or the epigastric, it is always accompanied by its corresponding vein; but besides this, it frequently happens, even where that artery presents its natural arrangement, that there is an obturator vein opening directly into the external iliac vein, near the brim of the pelvis. This vessel, however, is always, under such circumstances, placed out of the reach of the knife, and is situated behind the hernial sac.

Manec (*Op. Cit.* p. 29. Plate 2, fig. 3, 4.) has reported a singular anomaly of the venous system of this region. A vein was observed coming off from the lower part of the external iliac vein, from whence it ascended in a tortuous direction toward the umbilicus, where it escaped from the abdomen through an opening formed by a recession of the fibres of the linea alba, and formed a loop of three or four inches in length beneath the skin. It then reentered the cavity by the same opening, and ascended upon the left side of the umbilical ligament to the transverse fissure of the liver, where it opened into the sinus of the portal vein. A case very similar has been observed by Meniere, *Interne* of Hotel Dieu. *Archiv. Gén.* X. 381. In both these instances the situation of the anomalous vein was such, that if a crural hernia had taken place, the vessel would have occupied the internal boundary of the neck of the sac, and would of course have been divided in dilating the stricture inwards, as recommended by Gimbernat.

It may be proper in this place to advert to a pathological state of the superficial, or external epigastric vein of the abdomen, some examples of which have been observed within a few years. In a case observed by Hourmann, the history of which is reported in the *Archives Génèrales*, this vein was found enormously dilated in consequence of an obliteration of the inferior vena cava. (*Dictionnaire de Médecine*, Tom. I., p. 109. 2d edition.) Under these circumstances, the blood which is prevented from returning by the cava, is carried by the superficial vein in question by means of the numerous anastomoses which it forms with the branches of the axillary vein; this collateral venous circulation, together with the azygos, compensating for the obliteration of the abdominal cava. Velpeau has also reported a case of a similar kind; and Boyer mentions another, in which the vein was dilated to the size of a child's head.

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E. GEDDINGS.

§ 3. ABDOMEN; (*Deviations of Form.*) The vices of conformation of the abdomen may be divided into primitive and accidental, or congenital and acquired. The first are dependent upon some interruption or perversion of the *formative powers*, taking place before the fœtus has attained its perfect development, while the second are occasioned by some accident occurring after the organs and parietes of the abdomen have assumed the normal type which characterizes them when fully formed. The first division only will be considered under this head, the second appertaining more appropriately to the articles *Hernia, Wounds of the Abdomen,* &c.

We shall consider, 1st, those deviations of form which arise from a defective energy, or an interruption of the acts of the formative powers; 2, those which are occasioned by a preternatural activity of these energies; and 3, those which are dependent upon some perversion of their laws.

1. *Deviations of Form, dependent upon a defective energy of the formative powers.* (*Vices of Defect.*) The most extensive deviations of this kind are those in which the anterior walls of the abdomen, together with the corresponding portion of the peritonæum, are entirely or partially absent. Under these circumstances the abdominal organs are completely exposed, and have no covering either from the peritonæum or any other structure. The extent of this defect varies under different circumstances. Sometimes it is not confined to the abdomen, but also implicates the thorax, the whole extent of these two cavities being open upon their anterior face, from the neck to the pubis, and having their organs naked and exposed. More frequently, however, the vice of conformation is limited to the abdomen, in which case there is an opening either extending from the ensiform cartilage of the sternum to the pubis, or confined to some portion of this space. But as the walls of the abdomen are later in attaining their perfect development in the vicinity of the umbilicus than above and below that point, the deviations of form under consideration are more frequent in that vicinity than towards the superior or inferior portions of the region.

A satisfactory explanation of these phenomena can only be derived from a consideration of the laws which regulate the evolution of the different parts which are concerned. Modern researches upon this point have demonstrated, that all the organs are formed symmetrically; that at the period of their first development they consist of two lateral portions, placed parallel with each other, which are unconnected; that in proportion as the different parts become evolved, by a development which always extends from the circumference towards the centre, they unite upon the median line; this union, as it takes place upon the posterior and anterior faces of the head and trunk of the body, forming a cavity, posteriorly, for the brain and spinal marrow, and anteriorly, the nose, the mouth, and the thoracic and abdominal cavities. This law was long since noticed by WOLFF, and has been very ably investigated in more modern times by MECKEL, TIEDEMANN, CARUS, OTTO, GEOFFROY ST. HILAIRE, SERRES, and others. The latter gentleman has designated it the *law of eccentric development.* In the primitive condition of the organism, he observes, that "the fœtus is open throughout the whole extent of the median line of the anterior part of the body. There are two half faces, two half sternums, two half abdomens, and likewise two half pelves. The heart is situated out of the thorax, the intestines out of the abdomen, and the bladder exterior to the pubis. According to the law of *excentric development*, all these organs, situated at first upon the circumference of the body, are gradually inclined towards the centre, which they finally occupy. When they have reached this situation, the two halves of the sternum, the two halves of the abdomen, and the two halves of the pelvis, approximate and unite with each other upon the median line of the body, and thus obliterate hermetically the openings of the cavities, so that the organs cannot escape except by accident.

"But it will be seen, that if the progress of the viscera be arrested, or interrupted, by the contraction of unusual attachments, they cannot undergo these transitions, and will consequently remain in the condition which they present in the *embryo.* The two halves of the sternum, of the abdomen, and of the pelvis, being formed separately, a hiatus of variable extent, according to the circumstances of the case, will remain upon the anterior face

of the thorax, abdomen, or pelvis." (Serres, *Recherches d'Anatomie Transcendante et Pathologique.* 4to. p. 17. Paris, 1832.) Or should the organs themselves take their position within the central part of the cavities, while an arrest of development takes place in the lateral portions of the sternum, abdomen, and pelvis, the same defect of the walls of the corresponding cavities will be observed. This is precisely what occurs in the vices of conformation of the abdomen now under consideration. An arrest of development takes place in the muscles and other structures which form the anterior walls of that cavity, so that a permanent hiatus remains upon its anterior part, leaving more or less of the viscera bare and unprotected. Ruysch has reported a case in which the stomach, intestines, and spleen, were situated exterior to the cavity of the abdomen, and were destitute of any covering. The child survived several hours. (*Observat. Anat.* Observ. LXXIII.) Dietrichs (*Comm. Noric.* 1735. p. 67. Meckel, *Handbuch der Path. Anat.* Band I., p. 119.) met with a case in which a portion of the intestines protruded through an opening on the right side, in the vicinity of the umbilicus, and had no external covering. Meckel (*Handbuch der Path. Anat.* p. 119) and Fried (*De fœtu intestinis plane nudis extra abd. propend.* 1760. Meckel.) have described similar cases. Mery (*Mem. de l'Acad. des Sciences,* 1709.) reports a case in which a tumour of ten inches in diameter, formed by the liver, the stomach, spleen, and a large proportion of the intestines, was covered by two membranes, which he supposed to be the chorion and amnion. A case of a similar kind has been published by Howell, and two others are noticed by Meckel. (*Loc. Cit.* p. 122.) In a case recently reported by Robinson, (*American Journal of the Medical Sciences.* XI. 347. for 1833.) both clavicles, the sternum, and cartilages of the ribs, were absent, exposing the whole interior of the cavity of the thorax; the abdomen was also open as low as the umbilicus, to which point the margins of the chasm converged from the second false rib on each side: along the right margin, the umbilical chord appeared to ramify, and then to expend itself.

Much more frequently, however, the anterior portion of the peritonæum exists, and furnishes a covering for the viscera of the abdomen at the point at which the walls of that cavity are absent. Ruysch (*Observat. Anatom.* Observat. LXXI., LXXIII.) reports two cases of this kind. In a male child observed by Eschenbach, (*Observ. Anat.* 1753. p. 8. Meckel.) the skin and muscles of the abdomen were deficient from the sternum to the pubis, so as to present an elongated opening, of the width of the hand, in the course of the *linea alba.* The margins of the opening were folded backwards, and the organs throughout the whole extent of the intervening space were merely covered by the peritonæum. Preuss, (*Eph. Nat. Curios. Cent.* 7. Append. p. 118.) Saxtorph, (*Ges. Schrift.* Copenhag. 1803. Meckel.) and Merklin, (*Ephemerid. supra Cit.* Dec. 1, p. 74.) have described cases in which nearly the whole of the anterior walls of the abdomen were wanting, the viscera being merely covered by the peritonæum. In the case reported by Merklin, the anus opened above the pubis; an example of which was also observed by Meckel. In one of Saxtorph's cases, the liver, stomach, and intestines, were merely covered by the peritonæum, which also adhered to the internal surface of the *placenta:* the umbilical chord was only about three inches in length. This is somewhat similar to a case reported by Littre, (*Mém. de l'Acad. des Sciences.* 1709. p. 10.) in which the integuments and muscles of the abdomen were absent along the course of the linea alba, and the *amnion* adhered to the whole extent of the corresponding portion of the peritonæum. These two cases represent the relations and connexions of the membranes of the fœtus with the peritonæum, as they exist during the earlier periods of the development of the *embryo.*

These defects, as might be inferred from the nature of the causes by which they are produced, generally occupy the median line of the abdomen, and are, as has been represented by Meckel, (*Handbuch der Pathologischen Anatomie.* Band I., p. 125.) symmetrical in their character. In some rare instances, however, a departure from this arrangement is observed, the defect being confined entirely to one side of the abdomen. Thus, in a case quoted by Meckel from Elsholz, the parietes of the abdominal cavity were wanting on the left side, and the whole of the digestive organs were protruded through the open space. The manner in which this may take place can be easily explained upon the supposition, that while an arrest of development occurs in one half the abdomen, the formation of the other half advances, until it reaches the median line. This will of course leave a defect on the side in

which the interruption takes place, varying in magnitude according to the period of its occurrence.

Defects of the anterior walls of the abdomen, of more limited extent, are of not unfrequent occurrence. They are oftener observed in the vicinity of the umbilicus than in any other situation, and have been generally described under the appellation of *umbilical hernia*, though they may take place in any portion of the linea alba. When they do not occur at the umbilicus, or in its immediate vicinity, their most frequent locality is between that point and the sternum. Cases of this kind have already been cited under the head of Surgical Anatomy of the Abdomen, and the records of the science abound with examples, which, on account of their number, cannot be reported in this place. They are generally owing to an imperfect development of the umbilical opening of the abdominal parietes, or of some portion of the aponeuroses of the muscles at the point at which they unite along the course of the linea alba. In some cases of this kind the tumour is not larger than a small nut or a pigeon's egg, but occasionally it almost equals in magnitude the body of the child itself, and contains nearly all the organs of the abdomen. When the defect exists at the umbilicus, the tendinous aponeuroses are generally imperfectly developed in the immediate vicinity of the umbilical chord, and the organs may protrude between the vessels of the chord and the limited covering which they derive from the skin. Under these circumstances the umbilical vessels, in a large majority of instances, course along the lower part of the tumour, but are seldom seen running upon its superior surface.

Under the head of vices of conformation of the anterior walls of the abdomen, should also be enumerated those cases of exstrophy of the bladder, in which the corresponding portion of the abdominal muscles, as well as the anterior walls of the bladder itself, are deficient, the posterior wall of the organ presenting a raw secreting surface, upon which the two ureters generally open by a small fungous elevation, situated on each side. Numerous cases of this kind exist on record, in some of which the symphisis pubis has also been absent, while in others the bones were perfectly developed, and the defect was confined entirely to the soft parts. An example of this organic deviation of the walls of the abdomen and the corresponding portion of the bladder has been recently described by Dr. HAYWARD of Boston, in the Boston Medical Magazine. (I. 91.) He states that a similar case had fallen under his observation but a short time before. Another example has been reported by Mr. EARLE in the London Medical Gazette, for *April*, 1832, in connexion with some clinical remarks explanatory of the nature of the affection. (See *Am. J. Med. Sc.* X. 481.) Other cases have been described by Sir ASTLEY COOPER, COATES, and several other individuals; but the subject has been investigated with the greatest attention by BONN, (*Ueber eine seltene und widernatürliche Beschaffenheit der Harnblase und Geburtstheile.* Kehl. 1782.) ROOSE, (*Dissertatio de Vesicæ Urinariæ inversæ prolapsi.* Gött. 1793.) CREVE, (*Ueber die Krankheiten des weiblichen Beckens.* Berlin. 1795.) DUNCAN, (*Edinburgh Medical and Surgical Journal.* 1805.) and MECKEL, (*Handbuch der Pathologischen Anatomie.* Band I. p. 715.) who have cited nearly a hundred instances of various degrees of this anomalous conformation. It is less frequent in females than in males, though it is highly probable, as has been asserted by MECKEL, that the estimate made by DUNCAN upon this point makes the preponderance in the male greater than it is in reality. But whatever may be its characters, it is always occasioned by an arrest of development taking place in the two lateral halves of the inferior portion of the anterior abdominal parietes, before they are united with each other upon the median line; and a defect of the structures of this region, varying in magnitude, according to the period at which the interruption takes place, is the necessary consequence;—a defect, which not only involves the integuments and muscles, but in many instances even implicates the symphisis pubis, and the whole extent of the anterior wall of the bladder.

We shall not speak particularly in this place of those congenital defects of the diaphragm which sometimes allow one or more of the organs of the abdomen to pass into the cavity of the thorax. This constitutes a genuine *diaphragmatic hernia*, for the characters of which see *Hernia*. It will be sufficient, on the present occasion, to state that the characters exhibited by the organic deviation which takes place at this point, will differ according to the extent of the defect of the diaphragm, the presence or absence of the peritonæum upon the surface of the protruded organs, and the nature of the part which has protruded. The most usual seat of the defective development of the diaphragm is

immediately behind the sternum, or at the several points at which that muscle is traversed by the aorta, the œsophagus, or the vena cava. Whenever the resistance of any one of these points is too weak for the impulse communicated to the viscera by the walls of the abdomen, the organs may be forced upwards into the cavity of the thorax, and thus give rise to a diaphragmatic hernia. Meckel has figured the case of a hemi-cephalic fœtus, which was also affected with spina bifida, in which the stomach, the principal part of the small intestines, and the spleen, passed through an opening in the diaphragm into the left side of the thorax, and compressed the corresponding lung. (*Tabulæ Anatomico-Pathologicæ.* Fasc. 4. Plate 32. p. 15. Fol. Lipsiæ, 1826.) In a second case figured by the same distinguished anatomist in another work, (*Descriptio Monstrorum Nonnullorum.* 4to. Tab. III. Fig. 1. p. 26. Lipsiæ. 1826.) the left lobe of the liver, the stomach, and spleen, protruded through an opening in the left side of the diaphragm, of an inch and a half in diameter, and filled nearly the whole extent of the left cavity of the thorax. Other examples of a similar vice of conformation, observed in children at birth, have been reported by Zwanzig, (*in* Meckel. *Tab. Anat. Path. Sup. Cit.* Tab. 32. Fig. 2.) Macaulay, (*Med. Observations and Inquir.* Vol. I. No. 4.) Campbell, (*Edinburgh Med. and Surg. Journal.* XVII. 513,) &c. In one case described by Macaulay, the stomach and greater part of the intestines, with the spleen and part of the pancreas, were found in the left cavity of the thorax; and in a second case, the small intestines and part of the liver had protruded into the right cavity of the thorax. In an instance observed by Zwanzig, the stomach, spleen, and the small and large intestines, protruded through a large opening in the costal portion of the diaphragm of the left side, and entered the corresponding side of the thorax. Campbell has also reported a case, in which nearly the whole of the stomach, the small and the whole of the large intestines, except the descending portion, the spleen, and pancreas, occupied the left thoracic cavity; and in the *New-York Med. Repos.*, N. S. IV. 178, a drawing and notice of a case is given by Dr. Ramsay, in which the stomach and great intestines were transferred into the left thoracic cavity. Examples of this kind might be considerably multiplied, especially if we were to quote those cases in which the displacement in question has taken place rather as an acquired than as a primitive vice of conformation. But as those instances can be more appropriately brought in under the head of Hernia, we shall pass them over in this place. It may be stated, however, in conclusion, that when a considerable portion of the abdominal organs passes through the diaphragm into the thorax, their encroachment upon the organs of the latter cavity will tend to interrupt their development, or if they have been previously formed, to impede their functions, and occasion an atrophy of their substance.

2. *Deviations of Form dependent upon a preternatural activity of the formative powers.* (*Vices of excess.*)

As it is not our intention, in the course of the present article, to consider the vices of conformation of the individual organs, in which the influence of the preternatural energy of the *formative powers* is particularly manifested, in the multiplication of accessory organs or portions of organs, there will be little necessary to be said upon the few deviations of this character which implicate the parietes of the abdomen. These consist, for the most part, of the multiplication of the muscles and vessels; the inordinate prolongation of the ensiform cartilage of the sternum; the development of a second fœtus or some portion of a fœtus, in connexion with the abdomen of the first, &c.

The most simple deviation of the latter kind, is the attachment of a rudiment of an upper or lower extremity of a second fœtus upon the abdomen of one more perfectly formed. A case of this kind was observed by Plancus. (*De Monst.* Venet. 1748. p. 10. Meckel.) A lower extremity was engrafted upon the anterior face of the pubis, from whence it ascended before the abdomen, but was much less perfectly developed than the normal extremity of the individual. More frequently, however, the multiplication is much more considerable, the supernumerary parts consisting of a considerable proportion of the trunk or extremities of a second individual, or even of an entire fœtus perfectly formed, connected with the first, either by the anterior or lateral face of the abdomen. A great number of cases of this kind exist on record, but for an account of them we must refer to the works of those who have treated on the subject of monstrosities, and especially to those of Haller, (*Opera Minora.* Lib. III.) Van Dœverin, (*Observat. Anat.*) Ruysch, (*Thesaurus Anatomica.*) Meckel, (*De duplicitata Monstrosa.* Fol. Lips. 1826., also *Handbuch der Pathologischen Anatomie.*) Otto, (*Seltene Beobachtungen.*) Geoffroy St. Hilaire, (*Philosoph. An-*

atomique. 1822. Elbin, (*De monst. corde carent.*) Isidore Geoffroy St. Hilaire, (*Anomalies de l'Organization.*) Serres, (*Anatomie Transcendante.*) &c.

3. *Deviations of the situations and relations of the organs contained within the cavity of the Abdomen.*

The organs which occupy the cavity of the abdomen are subject to a great variety of displacements and transpositions. These may take place in a single organ, or may involve the whole of those which are included within the cavity; the displacement of one generally giving rise to a similar condition of some other; and when the preternatural situation of the different parts is owing to a congenital perversion of the laws which preside over their development, we sometimes find all the organs of the abdomen and thorax completely transposed, those which should occupy the left side of the body being placed on the right, and vice versa. Those parts which are most moveable are generally most liable to accidental displacements. Thus, the transverse arch of the colon, being merely confined by a thin duplicature of the peritonæum, is frequently found drawn from its natural situation, and in some cases even descending as low as the pubis, or into the cavity of the pelvis. Under these circumstances, it generally tends to carry the lower extremity of the stomach with it in its displacement; the upper extremity being fixed firmly to the diaphragm will of course resist the dragging force of the colon. The cœcum, as well as the ascending and descending portions of the colon, may also be displaced by the development of large abdominal tumours, and the agency of other causes, which by submitting the peritonæum to an inordinate degree of distension, expose the organs to a kind of traction by which they may have their situation and relations entirely changed. Many of these modifications in the position of the intestines are important in relation to the diseases to which they are liable; for it not unfrequently happens, that some mal-position of the colon, or even of the small intestines, occasions such an obstacle to the passage of the contents of the organ, as to submit the individual to violent and repeated colics, severe intestinal inflammation, and, in some cases, to strangulation and mortification. We have seen death occasioned by a constriction of the sigmoid flexure of the colon, in an individual in whom that intestine was so preternaturally long as to form numerous convolutions, in one of the folds of which a portion of it became constricted so as to occasion a complete obstruction to the course of the feces. This accident is generally facilitated by the development of adhesive inflammation upon the peritonæal surface of the intestine, by which its convolutions are frequently agglutinated, or numerous shreds or bands of an adventitious character are formed which may become a means of constricting the gut. The liver, spleen, pancreas, and kidneys, are also frequently removed to a considerable distance from their natural situation, either in consequence of an inordinate augmentation of their volume, or the influence exercised upon them by some neighbouring part. In some cases the right lobe of the liver has been found reposing upon the brim of the pelvis, and the right kidney low down in the iliac region, while the corresponding portion of the colon, the cardiac orifice of the stomach, and the duodenum, have also been drawn downwards considerably below the level of their proper position. The spleen and left kidney may be displaced by the same causes that influence the organs just mentioned, and have accordingly been often found lodged in the left iliac fossa, or even descending into the upper portion of the cavity of the pelvis. In all these cases, as the situation and relations of the organs are changed, corresponding modifications must be developed in their pathological manifestations. But as we cannot, under ordinary circumstances, be certainly apprized, during the life of the patient, that any displacement of the abdominal viscera has taken place, we should be exceedingly liable, in exploring the abdomen for the purposes of diagnosis, to form erroneous conclusions. Mistakes of this kind have been frequently made, and are very often unavoidable.

But the most remarkable examples of a mal-position of the abdominal organs, are those which consist of a complete transposition of a part or the whole of them. This deviation is seldom confined to the abdomen, but generally implicates the organs of the thorax at the same time, as well as the great vessels which arise from the arch of the aorta. The most simple deviations of the kind consist of a simple multiplication of the parts of an organ upon the one or the other side of the body. This is manifested in the division of the left lung into three instead of two lobes; a preternatural division of the right or left lobe of the liver; the development of the pyloric valve of the stomach in the cardiac orifice of that organ, while the usual arrangement of the pyloric orifice is deficient.

This disposition of the parts would seem, at first sight, to prove that a complete transposition of the organs had taken place; for when the left lung presents three lobes, the right presents merely two, and where a valve is developed in the cardiac orifice of the stomach, that of the pylorus is usually deficient. In the heart, moreover, we sometimes observe that the two ventricles seem to exchange characters, even though the arteries pass off as usual, the left ventricle being inordinately attenuated, while the right is thick and strong, and presents all the characters which generally appertain to the left. These phenomena are not the result of an absolute transposition, but arise from the influence of a law of the living organism which has been illustrated by Geoffroy St. Hilaire, (*Philosophie Anatomique*, p. 244.) and which he has denominated the law of *equilibrium*, (*principe du balancement des organs.*) According to this law, whenever one organ, or set of organs, acquires an augmentation of volume or development, such increase is made at the expense of some other. If then we make an application of this principle to the cases under consideration, we shall find, as already stated, that whenever the organ on the one side or the other has undergone a multiplication of parts, or an increase of volume, it has been at the expense of that of the other. Thus in the lung, which has been mentioned as an example, that on the right side usually presents only two lobes, where those on the left have been multiplied to three; and in the heart, the preponderance of development in the right ventricle is attended with a corresponding defect of the growth of the left. The same thing is observed in those cases in which the pyloric valve is formed in the cardiac instead of the pyloric orifice of the stomach. (Meckel, *Handbuch der Pathologischen Anatomie*, Band II. p. 183.) These facts demonstrate a gradual transition from the normal type of the organization to a state in which some portions of it assume an important deviation from that condition; and tracing out the different degrees in the scale, we shall find a variety of intermediate stadia, between a slight deviation in the situation of the organs concerned, and a complete transposition of those which occupy the left, to the right side of the body, and vice versa.

In those cases in which the deviation is more considerable, the transposition may involve the whole of the organs of both the abdomen and thorax, or it may be confined to one or more of them, the others occupying their natural situation. Thus in a case reported by Mentel, (Voigtel, *Pathologischen Anatomie*, Band II. p. 314.) the liver was situated in the left hypochondriac region, and the spleen in the right: the heart was also inclined to the right side of the thorax. Sandifort (*Obs. Anat. Fasc.* 1.) and Ludwig (*Obs. de Situ præternat. visc. inf. Vent.* Meckel, *Loc. Cit.*) found the cœcum in the left side of the abdomen; and Sampson (*Philosophical Transactions*, IX. 746.) reports a case in which the liver occupied the left; the spleen the right hypochondriac region. The first flexure of the jejunum, and the sigmoid flexure of the colon, were situated in the right side of the abdomen. The aorta descended in front of the vertebral column, but the vena cava was placed on the left side, where it passed through the fissure of the liver as usual. In a case reported by Heuermann, (*Phil. Bemurkungen*, Band I. p. 18. Meckel,) all the organs of the abdomen were transposed, while those of the thorax occupied their normal situation; and in a case observed by Abernethy, (*Phil. Transact.* 1793, p. 59,) a condition nearly the reverse of this existed: all the thoracic organs were transposed, while the liver occupied the median line of the abdomen, and had its lobes extending equally into the right and left hypochondriæ. The portal vein opened directly into the inferior cava without entering the liver, and the hepatic vein passed through the left side of the diaphragm.

The records of the science also furnish numerous examples of a complete transposition of all the organs of both the abdomen and thorax. We met with a case of this kind a few years ago in the body of a male subject, who lived to an advanced age; and Professor Smith, of the University of Maryland, has reported to us the particulars of a similar case, which occurred in a female. Other examples of the same nature have been communicated by Mery, (*Mém. de l'Acad. des Sciences*, 1743, p. 519,) Sue, (*Mémoires et Prix*, Tom. I. p. 292,) Morand, (*Hist. de l'Acad. des Sciences*, 1688, p. 44,) Hoffman, (*Cardianaster*, Lips. 1671,) Morenheim, (*Beitrage*, Band II. p. 305,) Bertrand, (*Cattieri*, XVII.) Baillie, (*Lond. Med. Jour.* 1789, Vol. X.) Gauberton, (*Mém. de Montpellier*, Tom. I. Hist. p. 110,) Larrey, (*Mém. de Chirurg. Militaire*, Tom. I.) Bichat, (*Treatise on Life and Death*,) Meckel, (*Handbuch der Pathologischen Anatomie*, Band II. p. 187,) Post, (*New-York Medical Magazine*, I. 166,) Hufeland's Journal, (Band XXII. p. 110,) and others which are referred to by Haller

(*Op. Minora*, Tom. III. p. 15,) Voigtel, (*Handbuch der Path. Anatomie*, Band II. p. 316,) Otto, (*Lehrbuch der Pathologischen Anatomie*, Band I. p. 27,) &c.

Many of the deviations of form which have been enumerated, especially those in which the organs are exposed, constricted, or protruded, may give rise to serious consequences, by embarrassing or interrupting the functions. A simple transposition, however, seldom interferes with the regular acts of the organs, and we accordingly find that many individuals in whom such an arrangement has existed, have attained a good old age without experiencing any inconvenience from the abnormal situation of their organs.

The abdomen is subject to several other deviations of form, but as they are mostly of an accidental or acquired character, they will be considered under their appropriate heads.

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Art. II. Abdomen. (*Physiological considerations relative to.*) Functions of the highest importance are performed within the abdomen. Chymification, chylification, the secretion of bile and of the pancreatic fluid, the excretion of urine, impregnation and the development of the fœtus, are all executed there. It is consequently the seat of the principal functions for the nutrition of the individual and the propagation of the species. These will be treated of under their proper heads.

The abdominal parietes, physiologically considered, present three points of view: 1st. As protecting the viscera they inclose; 2d. As exercising an energetic and constant pressure upon those viscera; and 3d. As performing certain movements by means of the muscles which enter into their composition. We shall briefly examine them in each of these aspects.

1st. The conformation of the abdominal parietes, like that of every other part of the organism, presents the most perfect relation between their structure and uses. If, then, we find that these parts do not possess in an eminent degree the power of protecting the viscera they envelope from external injury, this power has been sacrificed to a more immediate necessity, that of not impeding the functions of those important organs. The extensive changes which take place in the size of the abdominal viscera, either from the introduction of food and drink, the disengagement of gas, or the development of the impregnated uterus, exact a corresponding capacity for change in their envelope, a condition perfectly fulfilled by the soft and extensible parietes of the abdomen. The organs they inclose are not, however, entirely deprived of protection from external injury. The liver and spleen, whose parenchyma is easily ruptured, are sheltered under the base of the chest; whilst posteriorly, the vertebral column and the fleshy masses on each side of it, protect the two important vessels which pass in front of the spine, as also a part of the intestines. The iliac fossæ and the basin of the pelvis fulfil the same office for the viscera they contain. Finally, even where the parietes possess no hard parts, they are remarkably strengthened by the mode of superposition and the arrangement of the muscular and aponeurotic layers of which they are composed.

2d. The abdominal viscera are subjected, by their elastic and contractable envelope, to a constant and energetic pressure, which favours the performance of many of their functions. The food and drinks are propelled through a muscular canal, the parietes of which must remain contracted to prevent the regurgitation of its contents; and hence we also find fasciculi of fleshy fibres performing the office of sphincters to the orifices of the reservoirs of the abdomen. If these sphincters become paralyzed, pressure on the abdomen occasions the involuntary discharge of the contents of these reservoirs. It has been already observed that the abdomen is always filled by its organs; consequently, when its walls are opened, the air does not rush into it, as happens when the thorax is penetrated, (see *Chest;*) on the contrary, there is often an expulsion of some of its viscera, and this is especially the case when the intestines contain gas; for these organs, when deprived of the support of the abdominal muscles, are no longer able to resist the expansive force of their aëriform contents, and are consequently greatly distended, and a portion of them frequently forced through the wound. These considerations explain various phenomena of punctured wounds of the abdomen, and of hemorrhages and effusions within its cavity. Some of the functions performed within the abdomen being influenced by the structure of the chest, it is necessary here to remark, that the latter, in a healthy condition, is never entirely filled by the viscera it incloses, and consequently it exercises no pressure upon them; whilst, then, the former cavity is, if we may use the expression, too full; in the latter there is a tendency to a vacuum, or, to speak more philosophically, the exterior surface of its viscera are subject to a pressure less than that of the ordinary weight of the atmosphere. The muscular partition, the diaphragm, which separates these two cavities, is naturally pressed up towards the chest, and the passage of the fluids, through the vessels of the abdomen which empty into the chest, is facilitated by the condition of the cavities to which we have alluded. The influence exercised by the abdominal pressure upon the course of the blood in the vena porta, and the stasis which sometimes follows the relaxation of the abdominal parietes after the operation of paracentesis, were long since noticed; this pressure equally favours the passage of the fluids through the thoracic duct and ascending cava. Finally, the alternate contractions of the abdominal muscles, and diaphragm, promote the passage of the urine from the kidneys to the bladder, as also the flow of the bile and pancreatic fluid in the excretory apparatus of the glands which secrete these fluids.

3d. The motions performed by the abdominal muscles, are the flexion of the chest on the pelvis, or of the latter on the former; the rotation of one of these parts on the other, and their lateral inclination; and finally, various actions in which the movements of the abdomen are associated with those of the chest, as in straining and its different varieties, vomiting, the discharge of feces, of urine, and of the ovum.

Flexion is performed by the contraction of the oblique and recti muscles. When the pelvis is the fixed point, those muscles, in contracting, draw down the chest towards the former part; when the chest is the fixed point, the reverse takes place; and when the individual lies on his back so that neither of these points is fixed, they bend the body so as to approximate the anterior parts of the chest and pelvis. When the oblique muscles of each side

act with equal power, their effect is to produce direct flexion, and their action is then in perfect accordance with that of the recti muscles.

Rotation is performed by the external oblique of one side and the internal oblique of the opposite, contracting in concert; thus the simultaneous contraction of the right external and left internal oblique rotates the chest to the left, and *vice versa.* The contraction of the two oblique muscles of the same side produces lateral flexion without rotation.

The abdominal muscles are nearly or wholly inactive in ordinary respiration, but in forcible or sudden expiration and the actions which depend upon it, as coughing, sneezing, &c., they contract forcibly. The transversalis here acts in concert with the oblique and recti muscles, and their contractions alternate with those of the diaphragm. There are other cases in which all these muscles act simultaneously; as in certain efforts in which it is necessary that the trunk should offer a solid point of support to the muscles inserted into it; and in the evacuation of some of the abdominal viscera, to effect which it is required that the capacity of the abdomen should be diminished, as in the discharge of feces, urine, and in parturition. In these cases the action of the transversalis predominates over that of the other abdominal muscles; it represents, as observed by M. Berard, (*Dict. de Méd.* 2d Ed. I. 141.) a kind of contractile band, the action of which is not limited to the soft parts of the abdominal parietes, but also extends to the base of the chest, which is strongly compressed by this muscle. If it be remembered that the circumference of the diaphragm is almost everywhere united to the transversalis, that the former muscle occupies not only the superior but a great portion of the posterior walls of the abdomen, and that the latter fills the vast space between the chest and pelvis anteriorly, we shall have little difficulty in figuring to ourselves the abdomen as a large contractile sac, the contraction of which will occasion the evacuation of the smaller sacs contained within it. The contraction of the diaphragm pushes the viscera downwards and forwards; but the latter of these actions being counteracted by the abdominal muscles which press them backwards, the result of the combined actions is to push the viscera towards the perinæum, where the reservoirs which are to be evacuated are situated.

The expulsive contraction of the abdominal muscles is subjected to the will, but sometimes it is entirely involuntary, as we observe in vomiting, in parturition, &c.

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I. Hays.

Art. IV. Abdomen. (*Symptomatology.*) The great number and importance of the organs contained within the abdomen, and the frequency and diversity of their disorders, render that cavity, in disease, a fruitful source of symptoms, and these are often of a complex and multifarious character and consequently difficult of diagnosis. The means by which these symptoms are investigated will be hereafter described; (See *Exploration.*) in the present article we shall offer a sketch of only the results obtained by the several modes of exploration.

The changes in the abdomen observed in disease are in—1st, its temperature; 2d, its form, size, and appearance; 3d, its degree of tension and firmness; and 4th, its sensibility.

1st. The *temperature* of the abdominal surface furnishes important information in disease. It is generally increased in acute inflammation of the viscera of this cavity, as is particularly observed in enteritis and peritonitis; and this increase of heat corresponds with the situation of the inflamed organ. There is often no increase of temperature in chronic inflammations of the abdominal viscera; and after blows on the epigastrium, in anæmia, chlorosis, &c., there is sometimes a *diminution* of temperature. In many fevers and inflammations of the abdominal organs, the increased heat of the abdominal surface is accompanied with a peculiar acrid pungency to the sensation of the examiner; a phenomenon indicative of the utmost risk of rapidly supervening disorganization.

2. The *form* and *size* of the abdomen are susceptible of great changes, in consequence of the elasticity of its parietes and the various states of its viscera as to plenitude or emptiness. Among the most striking of these changes is that exhibited in ascites, in which disease the abdomen is enlarged in all directions, the epigastric hollow and iliac depressions disappear, and the umbilicus sometimes becomes prominent. In simple œdema of the abdominal parietes, the enlargement is neither so great nor so regular, and the change of form is principally observed at the sides, the abdomen enlarging without projecting anteriorly. In encysted dropsy and all other accidental tumours, the enlargement is local, at least at first, and is moreover very variable. In tympanitis, the enlargement, although more general, often allows

the undulating and semicylindrical projection of some portion of the intestine distended by gas, and especially the arch of the colon, to be distinguished. In peritonitis the abdomen is tumefied both by effusion into its cavity and a collection of gas in the intestines, thus combining the tumefaction of ascites and tympanitis. In some chronic diseases, the abdomen presents a condition the very reverse of the preceding, becoming concave, the osseous and cartilaginous parts which form its boundaries being prominent.

There are few peculiarities to be noticed in the *appearance* of the skin of the abdomen, except the red and lenticular spots which it commonly exhibits in typhus, (Dance, *Dict. de Méd.* 2d Ed. I. 143.) its shining and polished aspect occasioned by its distension in ascites; its numerous wrinkles after a fluid has been evacuated, or any other abundant depletion; and the great enlargement of its subcutaneous veins in some cases, an enlargement resulting, as would appear from the investigations of Dr. Reynaud, from the obliteration of some large internal vein, and indicating a supplementary circulation. We may add, that after parturition, wrinkles or folds of the skin form on the inferior and lateral portions of the abdomen, which are most conspicuous in those who have had the greatest number of children; a brownish line may be observed extending from the umbilicus towards the pubis, and there is a widening and thinning of the linea alba, principally in the umbilical region.

3d. The *increased tension and hardness* of the abdomen may be limited to its parietes or to the organs contained in its cavity. Apprehension of pain from pressure, the mere coldness of the hand, or even the simple touch, often occasions the contraction of the abdominal muscles; but in such cases these muscles generally relax after a time, especially if the patient's attention be diverted from our proceedings; but in inflammation of the intestinal mucous membrane it is often impossible to obtain their relaxation, the patient instinctively keeping these muscles in a state of tension in order to ward off the pressure from the morbidly sensible parts beneath.

When the increase of sensibility is restricted to a portion of the abdomen, the tension of the muscles usually corresponds to this limitation. The muscles in this state have been mistaken for deep-seated tumours, and the prominent bellies of the recti muscles supposed to be the inferior border of an enlarged liver, or a scirrhus pylorus; and they have given rise to various other errors in diagnosis.

The *increased firmness* is sometimes general, but much more frequently partial. In the last stage of tabes mesenterica and chronic peritonitis it is general, which has caused these two affections to be confounded with one another; but in the former, on pressure, isolated tumours, the enlarged mesenteric glands, may be distinguished, whilst in the latter the hardness is uniform. A partial increase of firmness occurs in many cases of engorgement or of tumours in the abdomen: thus tumours are found in the epigastrium from scirrhus or cancer of the stomach; in the right or left hypochondrium from engorgement of the liver or spleen; in the umbilical region from induration of the omentum; in the hypogastrium from distended urinary bladder, intumescence of the uterus or the presence of fibrous bodies in its substance; more to the exterior are those occasioned by excysted dropsy, and finally in the iliac fossæ those produced by an accumulation of feces or by phlegmonous tumours in the same regions. (Dance, *Loc. Cit.*) We shall treat elsewhere of the method of determining the seat and nature of these tumours.

4th. Many *morbid sensations* are experienced in the abdomen, which are all confounded together under the single epithet pain; but as each variety may have a peculiar signification, the symptomatologist should carefully distinguish them. Pain in the abdomen appears to occasion more anguish than in any other part of the body; it produces a remarkable alteration in the expression of the face, the countenance indicating not only suffering, but prostration and despair.

From their seat and peculiar characters M. Dance (*Loc. Cit.*) indicates the following varieties of abdominal pain: 1st. peritonæal, 2d. gastric or cardiac, 3d. intestinal or colic, 4th. hepatic, 5th. nephritic, 6th. vesical, and 7th. uterine. *Peritonæal* pain is acute, severe, superficial, and aggravated by the slightest pressure. *Gastric* or *cardiac*, the principal seat of which is in the epigastrium, is attended, notwithstanding its numerous grades, with more anxiety, sadness, and even despair, than any other pain. The *intestinal* or *colic* are characterized by being cutting, not constant, and accompanied with a sensation in the intestines of the movement of gas or fecal matters; they are also felt in the various parts of the abdomen when they affect the small intestines, and in the course of the colon

when they are seated in the large intestine; in the rectum when the pain is attended with a frequent and often ineffectual inclination to go to stool, as is observed in dysentery, it is termed tormina and tenesmus. *Hepatic* pain has a greater tendency than any other to be converted into a sensation of weight or heaviness, generally imperfectly described by the patient. *Nephritic* pain is principally seated in the renal region, but it often extends to the bladder, testicles, or groin, following the course of the ureters, and it is sometimes intensely severe, as when a calculus is in the ureter. *Vesical* pains extend over the hypogastric region and also to the perinæum, and are aggravated by the discharge of urine which frequently occasions a burning sensation. One of the peculiar characters of *uterine* pains is that they occasion, during and after parturition, the *cutting* and intermitting pains corresponding to the contractions of the uterus. Besides these pains which are for the most part attendant on inflammations, there are others which have a different signification; they are sometimes more severe than the preceding; as, for instance, that produced by lead colic, a pain which comes on in paroxysms and is commonly lessened by pressure.

Various other morbid sensations are experienced in the abdomen, but their characters are too indeterminate for them to furnish any assistance in diagnosis; M. Dance (*loc. cit.*) excepts from these, the epigastric uneasiness experienced by chlorotic females or those affected with profuse leucorrhœa; the lumbar and hypogastric pains which come on at the approach of menstruation, and the sensation of a ball rising up through the abdomen felt by hysteric persons; to these we may add the pain in one of the sides, especially the left, immediately under the margin of the false ribs and extending to the spine of the ilium of the same side, pointed out by Dewees (*Diseases of Females*, 1st Ed. 213.) as indicating a prolapsus of the womb. Finally, we may remark that the absence of pain and the insensibility of the abdomen to pressure offer no conclusive evidence of the non-existence of inflammation of the viscera of this cavity. Of this, numerous cases might be quoted, some of which will be hereafter adduced.

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I. Hays.

Art. IV. Abdomen. (*Pathology.*) The abdomen is the seat of numerous affections, and these may implicate its parietes, its membranes, its cavity or the several organs included within it. Among these disorders there are some which although they might be treated of in the general articles on those affections, offer peculiarities so dependent upon their seat in the abdomen, and embrace at the same time so many parts, that we could not consider them in any other than the present article, without involving repetitions and rendering it difficult to find the place in which these affections are discussed, the more so as some of the disorders of which we are about speaking, have not received any name which would lead the inquirer to seek for them under any other head than that of Abdomen.

We shall therefore treat in succession, of what is peculiar to each of the following diseases:—1st. Of physical lesions of the abdominal parietes and viscera (wounds, contusions, and ruptures); 2d. Of the lesions of the same parts resulting from other affections (effusions of various kinds in the abdomen, morbid adhesions of the viscera, fistulæ of the abdominal parietes); 3d. Of foreign bodies and accidental productions contained in that cavity, whether introduced from without or found within it; such as free concretions on the peritonæal sac; 4th. Tumours of various kinds, lipomatous, cancerous, or purulent, included in the abdomen but foreign to the viscera it contains; 5th. Tumours peculiar to the abdominal parietes or to the subjacent cellular tissue, among which are fatty tumours, encysted dropsy of these parietes, phlegmons and abscesses developed in the same situation, in the right iliac fossa, or in the inferior region after parturition: those purulent collections which sometimes form in the lumbar regions will, however, be treated of under the words *Psoas Abscess*, *Nephritis*, and *Abscess by Congestion; Stercorary* and *Urinary abscesses* will be discussed under those heads: although carbuncle and anthrax when seated in the abdominal parietes are more painful than in any other part of the body, they do not require particular attention here; 6th. Finally, we shall conclude this article with some observations upon the abnormal pulsations sometimes observed in the abdomen.

I. Hays.

§ I. Wounds of the Abdomen. These wounds are naturally divided into two classes; those which involve the parietes

only, and those which penetrate the cavity of the abdomen. According to the nature of the instruments by which they are produced, they are styled punctured, incised, lacerated, or contused wounds.

1st. *Punctured wounds of the abdomen which do not extend beyond the parietes*, frequently give rise to but little difficulty, or complication, and heal with considerable readiness; but in patients of an irritable constitution, in those who are excessively alarmed by the injury, and in cases where the instrument has produced contusion or partial division of a nerve, symptoms so serious and severe are frequently encountered, that we are at first inclined to believe that the wound has penetrated into the cavity of the abdomen. These symptoms generally pass away with the nervous agitation which produces them, or yield without difficulty to the local application of emollients and narcotics, to warm bathing, and the internal exhibition of opiates and antispasmodics. When severe pain continues notwithstanding the employment of these measures, and previously to the development of inflammation, it can only be accounted for on the supposition that a nerve has been punctured. Under such circumstances, it may be proper to infuse into the wound a watery solution of opium, the oil of hyosciamus, or some other powerful narcotic, of not too irritant a character. The free application of leeches around the wound, followed by long-continued emollient bathing, and large poultices impregnated with laudanum or prepared with the leaves of hyosciamus, belladonna, or stramonium, should then be employed. The infusion of these narcotics into the wound is, however, admissible only when its extent and direction are certainly ascertained; but it is not always possible to arrive at this certainty, as will be seen hereafter. If there exists the slightest chance of injury to the peritonæum, such infusion may prove highly dangerous. If these remedies fail, and the patient still labours under acute suffering, there remains no alternative but to enlarge the wound, in doing which, due care should be exercised to avoid the division of arteries, or the puncture of the peritonæum.

Wounds of this character, when they pass for considerable distances through the substance of the oblique or transverse muscles of the abdomen, into the sheath of the recti, or along the crista or costa of the ilium with injury to the periosteum, not unfrequently occasion inflammations more or less deeply seated and extensive. These inflammations are marked by acute pain coming on some days after the accident, by heat and tension, and sometimes a redness around the orifice of the puncture. The local symptoms are attended with traumatic fever of greater or less violence. This inflammation may be extended to the cellular tissue exterior to the peritonæum, or it may even involve that membrane itself. It sometimes terminates by resolution, at others by suppuration, and the pus secreted may make its escape along the track of the wound, or becoming confined, may give rise to abscesses, which in some cases are sufficiently obvious, but in others are detected with difficulty.

In the treatment of this inflammation, the usual remedies, such as general and local bleeding, a strict diet, mild drinks, emollient bathing or poultices, &c. should be steadily employed. When the pus is obstructed in its escape from the wound, the orifice, and if necessary, the canal also, should be enlarged. When an abscess is formed in the neighbourhood, it should be laid open as soon as its existence is discovered. In enlarging the wounds, and in opening the abscesses, the incisions, if made in muscular parts, should be carried as much as possible in the direction of the fibres, and care should be taken to avoid the larger arterial trunks, such as the epigastric, the branches of the internal mammary, the circumflex artery of the ilium, the vessels of the spermatic cord, and the lumbar arteries. When, in wounds of the description under consideration, the trunk, or a large branch of either of the arteries just mentioned is opened, attention should be immediately given to the consequent hemorrhage. The blood at first escapes freely from the external orifice, but in most cases it speedily becomes infiltrated into the cellular tissue, giving rise to extravasations sometimes extending to a great distance round the seat of injury, occasionally reaching even to the inguinal region and the scrotum. In addition to venesection and absolute repose, M. Marjolin recommends, for the purpose of arresting these hemorrhages, the employment of graduated compresses in the form of inverted pyramids, thoroughly imbued with cooling fluids, or a solution of alum, directing pressure to be effected by means of a tight body-bandage, supported by scapularies and strips of roller around the perinæum. Methodical pressure thus applied will often repress the hemorrhage, but it will be more successful in proportion to the small extent of infiltration which has taken place previously. If, however, a soft swelling, unattended by the usual signs of inflammation, appears

around the injured part, and goes on increasing after the adjustment of the proper compresses, it is reasonable to infer that the hemorrhage still continues, and it becomes absolutely necessary to enlarge the wound, and to search out and to tie the injured vessel, or compression must be immediately employed if the ligature be impracticable. (*Dict. de Méd.* 2d Ed. Art. *Plaies de l'Abdomen.*)

Simple punctured wounds of the abdominal parietes, require a simple treatment, consisting of rest, a low diet, mild drinks, and, if the patient is not in danger of pulmonary disease, cold applications. As soon as this first danger has received proper attention, the wound should be lightly dressed with a pledgit of lint spread with simple cerate, and this course should be pursued until the period at which inflammation may be expected, has elapsed. When, after extensive extravasation, the blood is not absorbed, it is recommended by MARJOLIN to open the cavity and evacuate its contents as soon as it begins to inflame. Considerable care should be exercised in following this advice, lest by interposing too soon we should increase the difficulty: vast collections of blood are frequently absorbed, and much time is occupied in the process: we distinctly recollect a patient who was admitted into the Pennsylvania Hospital some years ago, with fracture of the wing of the ilium, whose case was beautifully illustrative of this truth. The parts over the dorsum ilii, the groin, and scrotum, were distended by a mass of extravasated blood, so large that the peculiar emphysematous crepitation which has been frequently noticed in similar cases, and which is probably due to the escape into the cellular tissue of the gas eliminated during the act of coagulation, was perceptible over this whole surface; yet the patient recovered without the necessity of incision or the formation of abscess. Those who have examined, after death, the condition of fractures of four or five weeks' standing, well know how long coagulæ may remain in the midst of the common cellular tissue without proving a source of irritation. When the extravasation is superficial, it is safe to leave the case to nature; when deep-seated, we can hardly recommend any interference until the general symptoms warn us of the formation of an abscess.

As the front of the abdomen is almost covered with tendinous expansions, punctured wounds of its parietes are very frequently attended with symptoms much more severe than those which accompany similar injuries of other parts; and when inflammation takes place beneath those expansions, the system suffers violent disturbance, and suppuration is a very general consequence. When the inflammation is seated in the superficial cellular tissue, it requires no peculiar treatment; and should abscess result, its detection is easy and its proper management obvious. But when the inflammation is more deeply seated, it becomes necessary to employ the various means of combating it, with unusual vigor and decision, for there is always a danger that the inflammation may be extended to the peritonæum, which accident produces a most serious complication of the case. Absolute rest should be insisted on, and the body and lower extremities placed and preserved in such a position as to relax the abdominal muscles, and more especially those which are wounded. Venesection, and the abstraction of blood by leeches, should be carried to an extent proportioned to the violence of the traumatic fever and the local symptoms; the diet should be rendered as strict as possible; cold applications, poultices, and mild laxatives, are also proper in most cases. If, in defiance of our exertions, deep-seated abscess is formed, it is wrong to trust to the unaided efforts of nature for its evacuation; for though the well-known tendency of pus to make its way to the surface, is sufficiently obvious in these cases, yet the tendinous covering external to the cavity is so unyielding, and the division between the bottom of the abscess and the abdominal cavity so thin, consisting, in many cases, of the peritonæum alone, that a pointing internally and the inevitable death of the patient, may result from improper delay. When the pus is deposited within the sheaths of the recti muscles, or between the internal and external oblique muscles, it becomes diffused to a very great extent before it can approach the surface; and if it is at length evacuated externally, it flows in enormous quantity, leaving a cavity of great dimensions, which in itself constitutes a dangerous affection even when unconnected with inflammation or rupture of the peritonæum.

When, as is frequently the case, punctured wounds of the abdominal parietes take such a direction as to enfeeble the resistance which these parietes oppose to the escape of the viscera, proper support, by means of bandage and compress, should be invariably given to the injured part, and this support should be continued for some time after the apparent completion of the cure. When it becomes necessary to dilate the wound in consequence of any

of the accidents enumerated above, it is of course converted into an incised wound, and the precaution just mentioned becomes doubly necessary; for it is long before the new bond of union, when effected in muscular or tendinous parts, obtains sufficient strength to oppose the dilating or extending force of the intestines, acted on by the tonic pressure of the abdominal muscles. Troublesome or incurable hernia may result from a neglect of this precaution.

Incised wounds of the abdomen not involving the peritonæum or viscera, are dangerous, or not so, according to their extent and direction; but their treatment is simple. Their depth is more easily ascertained than that of punctured wounds; they are less frequently attended with symptoms simulating those of penetrating wounds; and by exploration with the finger, the integrity of the peritonæum can be ascertained in almost all cases. They are more frequently attended by free hemorrhage, and are less liable to ecchymoses. The danger of the consecutive formation of a hernial sac, is greater in proportion to their extent; and when muscular parts are traversed, this danger, and the difficulty of treatment, are increased if the incision divides the fibres obliquely. If hemorrhage is produced, the bleeding vessels are easily detected and secured by ligature. This done, and the coagula being removed from the wound, it should be accurately closed, and union by the first intention effected as speedily as possible. In a very large majority of cases, the coaptation of the edges is readily secured by adhesive strips, which should be of a length proportionate to the extent of the incision; but when the wound is situated in the course of one of the transverse duplicatures of the integuments, more especially if the patient is corpulent, a disposition to roll inward is displayed by the edges, and it may be impossible to bring them into accurate contact without the assistance of a few stitches of the interrupted suture. In aid of the adhesive strips, it is sometimes advisable to apply graduated compresses near the sides of the wound, and to act upon them by means of a broad bandage round the body, so as to assist in approximating and supporting the edges. This is most useful when the direction of the incision corresponds pretty nearly with that of the axis of the body. The wound itself should be dressed with a narrow piece of patent lint, spread with simple cerate, over the adhesive strips.

The position of the patient is of great importance; it should be such as to relax the muscles of the abdomen in general, and those which are injured in particular. Most writers direct the horizontal position; but when the wound is situated over or near the recti muscles, the knees should be considerably raised, and the shoulders and pelvis slightly elevated. When the lateral portions of the parietes of the abdomen are the seat of the injury, in addition to the former precautions, the shoulders and pelvis should be carried toward the affected side. When the incision is deep and extensive, this position should be carefully preserved until the completion of the cure; and the importance of this direction is obviously greater in transverse than in longitudinal wounds. To prevent the danger of consecutive hernia, the patient should continue to wear a belt, and should carefully avoid all violent exertion, particularly in lifting. Proper attention to the bowels during the treatment is highly important.

Contused and lacerated wounds of the abdominal parietes are, *cæteris paribus*, more dangerous than incised wounds, because there is much less certainty of effecting their union by the first intention; and when inflammation and suppuration supervene, the violence of the traumatic fever, the frequent occurrence of peritonitis, pain, nervous agitation, visceral disturbance, extensive ecchymoses, exhaustion from purulent discharge, and, in certain epidemic conditions of the atmosphere, erysipelas, are so many complications of greater or less importance, one or more of which will frequently occur in the progress of severe cases. The general plan of treatment is the same as that already laid down for punctured and incised wounds; and in order to avoid repetitions, we shall speak only of some additional precautions of more special application.

The immediate hemorrhage in contused and lacerated wounds is seldom severe, and ligatures are not required so commonly as in incised wounds; but after the careful removal of all foreign bodies, we should search for and take up any vessels of considerable dimensions which cross the direction of the wound. In lacerations, we should not place too much confidence in the temporary absence of bleeding, when there is reason to suspect a rupture of the epigastric, or other large artery, lest secondary hemorrhage should compel us to reopen the wound, a peculiarly unfortunate necessity in extensive injuries of the abdominal parietes. It should not be forgotten, however, that by too much handling and protracted examination for minute

ramifications, the chance of union by the first intention is considerably diminished. Upon little niceties, much of the difference in degrees of success depends, and this is a fine field for the exercise of tact.

It is seldom necessary to dilate wounds such as we are now treating upon, unless they involve the sheath of the recti muscles; but in this case the opening may be enlarged with great advantage in many instances. If the muscles are severely contused at the same time that their sheath is torn, this precaution should be very generally resorted to, in order to prevent the excessive pressure of the tendinous envelope upon its contents during the subsequent inflammatory swelling. Every exertion should be used to effect union by the first intention; and if this end is only partially obtained, still the partial success is highly important. Adhesive strips should always be employed when the coäptation of the wound can be accomplished by such means; and when the nature of the injury permits us to employ graduated compression, so as to act at a mechanical advantage in aid of the strips, it should be effected by means of suitable compresses, and a many-headed bandage. The roller is objectionable in all cases. Absolute repose, and strict attention to position, are of the utmost moment. M. Marjolin (*Dict. de Méd.* I.) states, that in the hospital to which he is attached, when patients with contused wounds are not liable to be affected with cough, cold water, or vegeto-mineral water combined with a small portion of laudanum, is found to be the best topical means of preventing inflammation. If this complication supervenes, it may be necessary to renounce the adhesive strips, more especially when the skin is erysipelatous, and the treatment must be restricted to dressing the wound with fine lint, over which is to be applied mild fomentations, or emollient poultices, the general antiphlogistic treatment being continued. We have had frequent occasion to notice the strong tendency to erysipelas produced by the continued application of adhesive plaster, during those periods when there exists an epidemic predisposition to this disease: and have even observed sloughs of the subcutaneous cellular tissue to follow the use of this, in cases unattended by any wound. Sir A. Cooper (*Lectures by Tyrrell*, III.) condemns its application to the edges of wounds, on the same ground.

When Delpech so happily succeeded in arresting the progress of hospital gangrene among the wounded of the Spanish army, received at *l'Hôpital Saint Eloi*, at Montpellier, he was compelled to discard adhesive strips, and depend upon the suture. Phlegmonous erysipelas often immediately checks the progress of union, and not unfrequently destroys it when recently formed. It is also extremely apt to extend itself very widely, endangering, in wounds of the abdomen, the occurrence of peritonitis, one of the varieties of which, the puerperal fever, prevails epidemically as a congener of this disease. The question may be started, therefore, whether, in lacerated wounds of the abdomen, when occurring during the prevalence of these epidemics, it may not be advisable to resort more frequently to the suture, than is customary in this country. The opinions of John Hunter in England, and Pibrac in France, have brought the suture under reproach, perhaps too generally applied. The school of Montpellier errs widely, we think, on the other hand; but we refer the reader to the work of Serre, *Sur la Réunion Immédiate*, for a candid and full defence of the suture.

When suppuration is completely established, and the traumatic fever has abated, it is unnecessary to pursue the antiphlogistic treatment with such absolute rigor; and when the inflammatory swelling and hardness have subsided, it is often injurious to continue too long the application of poultices, which tend to promote an undue secretion of pus. Much good may be done in many cases, and the progress of cure may be accelerated, by the judicious application of a bandage and compresses, so as gradually to contract the extent of the suppurating cavities.

The proper dressing for the wound after the omission of poultices, is patent lint spread with simple cerate, unless peculiar circumstances render other applications advisable. The treatment of erysipelatous inflammation and abscess from these wounds, should be conducted upon general principles, which will be discussed under the appropriate head.

The continued use of a belt, and the avoidance of great exertion, are still more necessary after lacerated wounds of the abdominal parietes, than after those which are produced by cutting instruments.

Gun-shot wounds of the parietes of the abdomen, require but little further notice. Those produced by splinters, or large fragments of various substances, being referable to the former sections, there remain to be considered those produced by small shot and balls. Small shot when lodged in the thickness of the skin should be removed, and if the number is considerable, a simple emollient poultice should be ap-

plied over the injured surface. When, however, they have penetrated to a greater depth, it is rarely necessary to trace them out, for very little inconvenience ordinarily results from their presence. Fatal cases have indeed occurred, but in these the shot are lodged far beyond our reach.

The nature of the wound produced by a ball is such, that union by the first intention is of course impossible; and as the surrounding parts are always either contused or have their vitality destroyed, but little immediate hemorrhage generally results; nevertheless, considerable ecchymoses occasionally take place. The danger from inflammation is greater in these than in other wounds, because the peritonæum, or even the viscera, may be seriously injured, although the ball may not have been in contact with them. Extreme care is necessary in all examinations for foreign bodies, particularly in deep wounds, lest the probe, the finger, or the foreign body itself, may irritate or puncture the peritonæum. The wound should seldom be enlarged, except when the ball has penetrated the sheath of the recti muscles, or when substances are lodged within it which cannot be extracted through the original orifice. The early symptoms are frequently such as to induce a suspicion that the abdomen has been penetrated, when this is not the fact. But great caution must be exercised in searching to assure ourselves by means of instruments that may verify our fears by their own action. In all doubtful cases, it is safe and proper to pursue the treatment best adapted to wounds which do not penetrate the cavity or the viscera.

2d. *Penetrating wounds of the Abdomen.*—It is customary to class under this head only such injuries as produce an opening into the serous cavity of the peritonæum; and although a part of certain abdominal and pelvic viscera, such as the kidneys, the great intestine, the uterus, and the bladder, may be wounded without injury to that membrane, yet the difference between these two kinds of accident is so important, that it is perhaps best to preserve the distinction.

Great attention has been given to the signs of penetrating wounds of the abdomen, because of the extreme gravity of the consequences which often supervene upon even slight injuries of this nature. The facility with which trivial and local irritations of the serous tissues give rise to severe and general inflammations, is well known. Even when the peritonæum alone is wounded, without any lesion of the viscera, and, as John Bell remarks, "although the injury be almost too small to be visible on the outside, and scarcely within," fatal inflammation of the whole surface of the membrane may result in an astonishingly short time.

Daily experience proves, however, that such consequences do not very frequently follow slight punctures when the integrity of the viscera is preserved, and when no unusual peculiarity in the instrument, or in the condition of the patient, gives rise to additional danger. Thus, after the operation for paracentesis, we do not anticipate the occurrence of peritonitis; after that for strangulated hernia, when it is necessary to enlarge the mouth of the sac, it is not very frequent; and the occasional success of the cæsarian operation, and that for the removal of the diseased ovaries, in which the wound has been closed by ligatures passed through the peritonæum, prove beyond a doubt that even very large openings into the cavity of the abdomen are not necessarily followed by dangerous symptoms.

The diagnosis of penetrating wounds of the abdomen, is very easy, provided the opening is large. The eye or the finger can at once determine the nature of the case. The view obtained of a portion of the stomach, an intestine, or the omentum located at the bottom of the wound or protruding from it, is the best possible evidence; but we may be deceived for a moment, as Boyer has observed, by mistaking a projection of the subcutaneous fatty tissue for the epiploon. When the eye cannot aid us, the finger recognizes with facility the external surface of the viscera and the smooth internal side of the peritonæum. Here again, however, some attention is necessary to avoid being led astray by the surfaces of aponeuroses, over which the finger may glide to a considerable extent in corpulent subjects. The opening of the cavity being ascertained, there still remains great uncertainty as to the number and extent of the injuries inflicted upon its contents, which are generally better understood from the course of consecutive symptoms, than from any examination which is admissible at the time of the accident.

When the wound is too narrow to admit the finger, it has been recommended by some surgeons to explore it by the probe. This plan is liable to several objections. The passage of the instrument is frequently rendered very difficult in consequence of the sliding of the various planes traversed by the weapon or body producing the wound; so that the apertures in the integuments, aponeuroses, muscles, cellu-

lar tissue, &c. do not coincide. It may also induce hemorrhage by disturbing the coagula formed upon the mouths of divided vessels; or it may irritate, detach, or tear the peritonæum. In fact, the knowledge obtained by the use of the probe seldom compensates for the pain inflicted by its introduction; and it is no longer considered correct surgical practice to employ it with the simple intention of ascertaining the depth of the puncture. Mr. Samuel Cooper says, that "it may be set down as an axiom in surgery, that in general, *whenever the probing of a wound is not rendered absolutely necessary by some particular object in view*, it may be judiciously omitted." (*Dict. of Surgery*, Art. *Wounds.*) When, however, it becomes indispensably necessary to search for foreign bodies carried into the wound, we should use the utmost caution, the sound or probe employed should be blunt and flexible, and the patient should be carefully placed in as nearly as possible the same attitude as that in which he was when he received the injury. A surmise as to the extent and direction of the wound may sometimes be grounded upon a comparison between the dimensions of the orifice and those of the weapon by which it is inflicted; but when the latter is furnished with a cutting edge, we may be deceived by the enlargement of the incision in the act of retracting it. All wounds of the abdomen should be treated as superficial, unless the accidents and symptoms of the case render it obvious that it is of a graver character; for simple puncture of the peritonæum, or even of an intestine, when unattended by alarming complications, does not require any modification of the treatment; and great injury may be done by the endeavour to ascertain a fact which, when known, is often of little importance.

The symptoms, both local and general, attendant on penetrating wounds of the abdomen, when the peritonæum alone is involved, or when the injury to the viscera is slight, are frequently as mild as those of the most simple wounds of the parietes; but in many other cases they are widely different. They may be ranged in two series; firstly, the rational signs, and secondly, the certain signs of penetrating wounds. Among the former, are classed a deep-seated pain felt by the patient at the moment of the accident, and continuing afterwards; paleness of the countenance; a jaundiced hue; excessive thirst; nausea, vomiting, and hiccough; spasmodic tension of the abdominal muscles; tympanitis; a small, frequent, and concentrated pulse; coldness of the extremities; faintness; spasm of the muscular system generally, &c. All these phenomena are occasionally seen, singly or combined, in simple wounds of the abdominal parietes; they are also absent in many cases of penetrating wounds. The rational signs are, therefore, insufficient to establish a certain knowledge of the nature of the accident; by their aid, however, we may estimate the probability of injury to the cavity or its contents, which is of course greater in proportion to the number, violence, and obstinacy of these disturbances combined in the case.

The certain signs of penetrating wounds of the abdomen are few in number. The possibility of introducing the finger into the cavity, and that of the issue of a portion of intestine or omentum, exist only in wounds of certain dimensions; but the escape of intestinal gases, chyme, feces, bile, urine, or blood from the liver or spleen, may take place from the narrowest punctures, and remove every doubt of their nature. Marjolin says that he has seen a considerable emphysema occasioned by a penetrating wound involving the superior part of the descending colon. In many cases we meet with bloody ejections and stools, or the evacuation by the urethra of blood, either pure or mixed with urine; and we are also certain that the abdomen is opened when those symptoms supervene which mark the effusion into the peritonæum of any of the intestinal contents or secretions. (*Op. Cit.*)

It is difficult in many cases to determine precisely what particular organs are injured by penetrating wounds of the abdomen, and to what extent they have suffered. An accurate inquiry into the attitude of the patient at the moment of the accident, the nature of the instrument or weapon producing it, and the probable depth to which it has entered, together with a careful examination of the discharges, if any occur, furnish us with our most certain lights. Such wounds occasionally interest, not only the cavity of the abdomen, but that of the thorax also, with its parietes and contents; the symptoms already enumerated are then complicated with others characteristic of wounds of the chest, under which head they will be described. The diagnosis of such cases is extremely difficult, unless the track of the weapon is rendered obvious by its having completely transfixed the body, producing two orifices in the integuments.

In judging the nature of wounds of the abdomen by the discharges, it should not be forgotten that urine may escape from

the bladder or the kidney, or feces from the great intestine, through a puncture which has no connexion with the peritonæum; for a considerable portion of each of these organs is left uncovered by that membrane.

We have said that punctured wounds penetrating the abdomen, when unattended by any complication, are frequently cured without the intervention of any serious symptoms; but it would be highly criminal to neglect the means necessary to prevent the occurrence of peritonæal inflammation in any case where there is the least reason to suspect an injury of this nature. The wound should be closed with the greatest care, and strict repose enjoined. The anodyne and emollient applications recommended in the previous section, are equally useful here; and the antiphlogistic treatment should be pushed with a degree of vigor in accordance with the violence of the consecutive symptoms and the strength of the patient. The diet should be entirely fluid, and when necessary the mildest laxatives may be given. Castor oil is preferable to any other cathartic, but whenever it is possible to keep the bowels sufficiently open by means of enemata, no other measures should be employed, and cathartics should never be administered during the first few days, unless under very peculiar circumstances.

At the same time that cautious attention and a decisive practice are recommended in the simplest cases, it should be borne in mind that in the most severe, there is no necessity for despair; our exertions should not be relaxed because the extent of the mischief induces an unfavourable prognosis. The annals of surgery are rich in proofs of the wonderful powers of nature in effecting a cure under circumstances apparently desperate. A small-sword is not unfrequently passed completely through the abdomen, and yet the patient recovers without difficulty; and Hennen, in his Treatise on Military Surgery, relates the case of a soldier whose abdomen was pierced by a ramrod, the end of which was so fixed in the spine that considerable force was required for its removal; the result was nevertheless favourable. It was formerly supposed that the weapon, in injuries of this character, pushed aside the intestines and passed through the cavity without wounding them; but since we have become familiar with the rapidity with which the surfaces of the serous membranes may contract adhesions to each other, and the extent to which false membranes are often formed within their cavities, the subject has been much better understood, "for we now know," says John Bell, "that in a thrust across the abdomen, six turns of intestine may be wounded, each wound may adhere; adhesion, we know, is begun in a few hours and perfected in a few days; and when it is perfect, all danger of inflammation is over; and when the danger of inflammation is over, the patient may walk about." The cure is effected by the agglutination of the corresponding edges of the different wounds in the intestines and the peritonæum, and not by a speedy closure of the openings; for a passage from one viscus to another may still exist after all communication with the cavity of the peritonæum is in this manner foreclosed. It is necessary, however, to the safety of the patient, that the adhesion should be formed before any effusion can take place.

By many writers the introduction of atmospheric air is supposed to be one of the principal causes of the serious inflammations which follow these wounds. John Bell has very fully exposed the fallacy of this idea, in criticizing the opinions of A. Monro in his work on the bursæ mucosæ. There being, as already stated, no void space in the peritonæal cavity for the admission of air, if there be any irritation occasioned by this agent it must be confined entirely to the surface of the intestines exposed at the orifice. This exposure is seldom or never so long continued as to produce the more serious danger of exsiccation. Even when the wound is large enough to permit of the protrusion of the bowels, the muscles contract upon the remaining contents, and the results of the extensive incisions and the handling of the viscera in cæsarian and ovarian operations, put at rest for ever the terror of the influence of air as a cause of material difficulty. (See *Air*.)

Peritonitis, more especially general peritonitis, is most frequently occasioned by the effusion of acrid substances, such as chyme, fecal matters, bile, or urine. It appears almost immediately upon the effusion, is extremely severe, and almost always speedily mortal. Local peritonitis, or that which is confined to a particular portion of the membrane, commonly depends upon less irritating causes, such as the direct effect of the wound, or the effusion of blood: it comes on more tardily, and is susceptible of cure.

Patients with traumatic peritonitis often succumb after languishing for some months; or, if they survive, they remain for a long time subject to pains in the abdomen and great disorder of the digestive

functions. Violent peritonitis sometimes terminates by gangrene. (MARJOLIN, *Op. Cit.*)

The proper treatment of traumatic peritonitis consists in the most vigorous employment of the antiphlogistic remedies. Bleeding, both general and local, should be carried to the greatest extent which the patient's strength will permit, and long-continued warm emollient baths are recommended when they can be endured. By these means, the local and the milder cases of general peritonitis may be conquered.

All the organs contained in the abdomen are liable to be involved in wounds of this character, but the pelvic viscera are so protected that they are seldom injured unless when in a state of plenitude. The gravid uterus and the distended bladder enjoy no immunity.

Wounds of the *liver* and *spleen* are very serious, though not necessarily fatal. In consequence of the great vascularity of these organs, the internal hemorrhage is generally very profuse, and too frequently speedily mortal. These viscera being fixed, when we know the depth to which a weapon has penetrated and the direction of its track, it is perfectly easy to determine how far they are implicated; but when these points cannot be ascertained, we are sometimes left in doubt. Wounds of the liver are for the most part attended by a more or less general jaundice, with discoloration of the skin, dejections, and urine, and according to HENNEN, a great and distressing itching of the skin. (*Military Surgery*, 3d Ed. 434.) The pus from the wound is sometimes yellow and viscous from admixture with biliary matter. A tender and contracted abdomen, continued vomiting, hiccough, and irregular chills, are generally present, but cannot be considered completely diagnostic. The difficulty and pain in respiration may lead to a stronger presumption of injury to the liver—particularly if it is strongly marked before the occurrence of inflammation. BOYER states that, in injuries of the convex or diaphragmatic surface, the pain is of that dull heavy kind so familiarly met with in chronic hepatitis, extending to the shoulder and larynx; while in wounds of the concave surface, it is sharp, and is referred to the neighbourhood of the ensiform cartilage. The character of the effused blood may show that it flows from the portal vessels, and if the hemorrhage is very profuse, the probability of a wound of the liver is increased.

In the treatment of these accidents, the first object is to arrest the bleeding. Venesection carried to a sufficient extent with a bold hand—cold applications and cold acidulous beverages, with pressure upon the part when it can be endured, are the obvious means of accomplishing our purpose. The after-treatment is conducted on general principles—the antiphlogistic measures being pursued as strictly as possible. Gentle laxatives should be employed whenever the bowels are not freely open, and toward the conclusion of the case, when the liver is the part affected, small doses of calomel are frequently advisable.

Wounds of the *gall bladder* have always been considered necessarily fatal, until very recently. There are two cases of recovery mentioned, one by PAROISSE, (*Œpuscules de Chirurg.* p. 255.) in which a bullet remained two years in this vesicle; the other by FRYER, of Stamford. (*Med. Chir. Trans.* V. 330.) The latter case was a rupture, without external wound, produced by a violent blow from the shaft of a cart, on the region of the liver. The injury was followed by pain, frequent bilious vomiting, great sinking, coldness of the extremities, and a weak, small, and fluttering pulse. Inflammation supervened on the third day, and ran very high, but was in some measure relieved by active treatment. About a week afterwards he had an exacerbation and was completely jaundiced; his stools were white, but the pain and tension soon abated. In two days from this time fluctuation was perceived in the abdomen, which, in another week became considerably distended with fluid. The swelling was then punctured, and thirteen pints of what appeared to be pure bile were obtained. Fifteen pints were drawn off, at a second operation twelve days after; in nine days more a new puncture gave exit to thirteen pints, and in a fortnight, six pints more were obtained in the same manner. From this time the patient began to recover. MARJOLIN does not admit that this fact affords proof that there was a wound of the gall bladder, but that a violent contusion of the liver had occurred, occasioning the exhalation into the cavity of the peritonæum, of a large quantity of serosity, which in consequence of its yellow colour was mistaken for bile. A similar serosity is often found in the cranium, the pericardium, the peritonæum, and in the synovial membranes of persons who die jaundiced.

SABATIER considered this accident certainly fatal. (*Méd. Op.* I. 34.) One case observed by himself terminated on the third day, a few hours after a puncture

had been made at the lower part of the abdomen, and a dark green, inodorous fluid drawn off. A post mortem examination exhibited the gall bladder perforated and empty, and the bile effused in front of the intestinal convolutions, which were glued together by a thick coating of lymph. (See *Abdomen, Effusions into the.*)

Wounds of the *spleen* have no peculiar rational signs by which they are distinguished from those of other solid organs, except the nature and the amount of the hemorrhage, almost always internal, and the location of the pain. They are fully as dangerous as those of the liver. A remarkable case of wound of the spleen, followed by recovery, is related by Dr. Powell, in the *Am. J. Med. Sc.* I. 481.

Punctured wounds of the *stomach* are not uncommon, and though very dangerous they are not always mortal. The accident most to be dreaded is an effusion into the peritonæal cavity, but if this is prevented by rapid adhesion, the patient may recover. There may remain, however, a fistulous opening which cannot be healed, and the contents of the stomach may find an exit through this passage. Such a state of things is not invariably productive of great danger or inconvenience. (See *Fistulæ of the Abdomen.*) In addition to the rational signs common to all penetrating wounds of the abdomen, we observe in these cases, vomiting of matter more or less tinged with blood, sometimes of almost pure blood; similar discharges per rectum, excessive thirst, and frequently, the escape of a portion of the contents or natural secretions of the stomach, by the wound.

Continued vomiting is productive of great inconvenience from the agitation which it produces, and from the inverted peristaltic action returning the contents of the duodenum into the stomach, on which account bile is sometimes found among the effusions or mingled with the substances escaping from the wound. In addition to the employment of venesection, warm emollient and anodyne applications to the whole abdomen, &c., we should be careful not to suffer anything to enter the stomach until time has been given for the formation of adhesions: this is generally effected in twenty-four or thirty-six hours. To relieve the excessive thirst, during the first day the mouth should be frequently moistened with cool water either pure or acidulated, and bathing the whole body with warm water will aid in alleviating this troublesome symptom: emollient injections are also recommended. When the adhesions are formed, mild and mucilaginous drinks may be given.

When the hematemesis is alarming in amount and the pulse becomes extremely feeble, it is then improper to draw blood from a vein; and when the hemorrhage cannot be commanded by the application of ice or other local measures, Boyer recommends the administration by the mouth, of a solution of alum, in the proportion of a drachm to four ounces of water.

Punctured wounds of the *intestines* are attended by nearly the same train of symptoms which characterize similar injuries of the stomach, though by the depth and direction of the wound when known, and sometimes by the nature of the discharge, we can form a tolerable surmise as to what part of the canal is injured. More danger is incurred by a puncture of a small intestine, than by that of the colon, because the process of nutrition is more embarrassed and there is greater probability of effusion. The treatment of punctured wounds of the intestines unattended by effusion resembles that already recommended in wounds of the stomach. When they take place shortly after a meal, M. Marjolin advises that vomiting should be induced, by tickling the fauces with a feather, in order to lessen the danger of effusion. All other means of producing emesis are obviously improper.

It sometimes happens that a fold of intestine is forced out through an exceedingly narrow wound, and becomes so tightly embraced that it cannot be returned. This is the only case in which it is proper to enlarge the peritonæal orifice, such a step being altogether inadmissible, for the purpose of ascertaining the extent or nature of the injury. We may find it necessary to cut down upon, and take up, a wounded artery in the parietes of the abdomen, but our incision is then superficial. Care should be taken, when dilatation is absolutely necessary, to divide the parts as much as possible in the direction of the fibres, and to avoid not only the larger arteries, but also the suspensory ligament of the liver, for the umbilical vein sometimes continues open, and fatal hemorrhage may result from a division of this vessel.

Sometimes when the reduction appears impossible, without dilating the wound, we succeed by withdrawing an additional portion of the intestine and by very gently urging its contents into the abdomen.

Effusion, the most dangerous of all complications with wounds of the intestines, does not occur very frequently in punc-

tured wounds; but the explanation of this fact, and the symptoms, results, and treatment, of effusions, will be found under a distinct head. (See ABDOMEN, *Effusions into the.*)

Passing over wounds of the *omentum* and *mesentery*, which differ in no respect from those of the peritonæum, of which they are duplicatures—we come next to those of the *kidneys* and *ureters.* These parts may be wounded either through the abdominal cavity or from behind, so that the peritonæum may be involved or not, according to the nature of the accident; but such injuries are uncommon, owing to the small dimensions and well-protected location of the organs—those of the ureters, in particular, are of course exceedingly rare.

As in contusions and inflammations of the kidney, so in these injuries, very severe pain is felt. It is not confined to the wound, but generally extends throughout the track of the ureter to the neck of the bladder, and along the spermatic chord to the testicle, which is often strongly retracted. The sharp pain, referred by the patient to the spine, and the intolerance of the slightest movement of the vertebral column, are strongly diagnostic. Frequent and irregular chills, often momentary in their duration, are more remarkable in these than in most other wounds of the abdominal viscera. "Nausea, vomiting, hiccough, and a general anguish, are produced by these wounds, in some cases, and may even occasion a sympathetic jaundice." (MARJOLIN, *Op. Cit.*) The discharge of bloody urine is the most certain of all the signs of such injuries.

The terrible inflammation induced by urinary effusions into the peritonæum will be spoken of under the proper head; but it is necessary to remark in this place, that whether the peritonæum escapes or is penetrated, the urine may be diffused into the cellular tissue external to that membrane, producing extensive destruction. When this is the case, there is observed, in a few days after the accident, an obscure fluctuation, generally accompanied by more or less emphysematous crackling, produced by the gases eliminated from the gangrenous parts. The collection of urine may approach the surface in any part of the lumbar region, and if the original wound cannot be so enlarged as to give ready egress to the effused fluid and the sloughs which it occasions, free counter-openings should be made in a suitable situation: their direction should be such as not to endanger the lumbar arteries. We have seen two cases of extensive urinary effusion into the scrotal cellular tissue, consequent upon the rupture of the urethra, in which an early counter-incision prevented the formation of sloughs; but such instances must be extremely rare, and probably depend upon peculiar idiosyncracies.

The treatment of wounds of the kidneys and ureters, requires little additional notice. All the antiphlogistic measures should be carried very far; and as we are scarcely ever sure that the intestines have escaped injury in such cases, the precautions with regard to food and drinks, laid down under that head, should be strictly observed. The evacuation of the great intestine by means of frequent but mild clysters, is of the utmost importance; for an accumulation of feces is productive of much distress in all cases of irritation in the kidney.

Punctured wounds of the *bladder* are generally recognized by the flow of urine through the wound. Blood, either fluid or coagulated, is evacuated by the urethra, or, as sometimes happens, retention of urine is occasioned by the coagula clogging the orifice of that canal. Pain and a sense of tightness over the hypogastric region, pain along the urethra, and at the anus, are common symptoms, and these are sometimes combined with sickness, hiccough, and, more rarely, with actual vomiting. Too often, the signs of urinary effusion into the peritonæum or into the neighbouring cellular tissue, supervene in the course of a few hours. Wounds of the bladder, like those of the kidney and ureters, may or may not be complicated with puncture of the peritonæum. In the former case, death is almost always the consequence. In the latter, though the peritonæum is not interested primarily, it may become involved in a secondary manner, from the effusion of urine into surrounding parts, and the consequent extension of the inflammation to the abdominal cavity. Though very serious, these cases are not necessarily fatal. Safety mainly depends upon the ready egress of the urine, either by the natural passage or by the wound itself. When the puncture is made into the upper part of the bladder while that viscus is in a state of distension, the contraction which takes place upon the evacuation of its contents gradually lessens the orifice, and diminishes or removes the danger of subsequent infiltration: such wounds are therefore most serious when the bladder is empty at the moment of the accident. Wounds by the bayonet, lance,

small-sword, &c. may enter the anterior surface of the bladder above the pubis, and after passing completely through it, make an exit near its neck, and perhaps involve the rectum, without injuring the peritonæum, and the patient may recover, unless the internal hemorrhage is too extensive. When the bladder is opened on its anterior part above the pubis, after the first jet, the urine does not flow steadily, but by fits, as the bladder becomes distended again and again. When the orifice is situated lower down, the percolation is more constant. In the former case, if all accumulation of urine in the bladder is prevented by surgical means, the wound may remain closed from the first, and it then heals without difficulty, provided there has been no previous effusion into the abdomen, nor diffused infiltration into the cellular tissue.

In the treatment of wounds of the bladder, the first indication is to give a ready passage to the urine through the natural canal. A catheter as large as possible should be immediately introduced, and allowed to remain in the urethra. Difficulty is sometimes experienced from the coagulation of blood in the bladder, which may prevent the egress of the urine; and it has been recommended to attempt the removal of the blood by means of an exhausting syringe adapted to a catheter or other tube. The supernatant urine may be drawn off by pushing the catheter through the coagulum; and when these means fail, it has been advised that we should throw in a stream of warm water through a sound with a double current, in order to dilute and wash it away. (Marjolin, *Op. Cit.*) Larrey, indeed, asserts, that blood rarely coagulates in the bladder, because of its admixture with urine. (*Chirurg. Milit.* Tom. IV. p. 295.) Even when it does coagulate, its presence is not always productive of very serious symptoms, when unattended with rupture of the urethra, or any other barrier to the introduction of the catheter; for the urine will dissolve the coagula, as is shown by a curious case narrated by Dr. Condie in the N. A. Med. and Surg. Journ. v. IV. p. 259. The catheter should never be omitted until the completion of the cure, but it requires changing every few days, for it rapidly becomes covered with incrustations, which may render its withdrawal very painful and difficult if this precaution is neglected.

The proper position for the patient is that in which the wound is dependent, and the abdominal muscles in a state of relaxation. For the rest, the treatment should be conducted on general principles. When collections of effused urine take place either in the perinæum, the scrotum, or above the pubis, early and free incision is necessary for their evacuation.

Wounds of the unimpregnated *uterus*, are extremely rare; but when gravid, this organ is more frequently subject to them. Serious or fatal hemorrhage, or the effusion of the liquor amnii and blood into the peritonæal cavity, are a common consequence of such injuries, and a consequent abortion must follow when the wound extends beyond the mere parietes of the organ. The most active antiphlogistic treatment is required in every case.

Wounds of the *diaphragm* are almost always complicated with injuries to other parts contained in the abdomen or thorax. Their signs are variable, and often obscure. Among them are noticed, difficult and painful respiration, performed with but partial expansion of the chest; pains extending to the shoulders and neck; a contracted or shrunken countenance; and above all, the risus sardonicus. In addition to the antiphlogistic treatment, it is proper, in wounds of the diaphragm, to administer gentle narcotics, to apply opiates externally, and to prevent too great movement of the ribs in respiration by giving firm support with a bandage to the lower part of the thorax. The head should be supported upon high pillows, and the shoulders should also be elevated. (Marjolin, *Op. Cit.*) Wounds of the great abdominal blood-vessels are generally followed by a very speedy death. They require no especial notice here, as they are beyond the reach of surgical aid; and the few recoveries that occur are due to the unaided powers of nature, or to accidental circumstances beyond our control. (Vide *Abdomen, Effusions into the.*)

Punctured wounds of the abdomen may be complicated with the presence of foreign substances. Large bodies which have been taken into the stomach, others which have entered and been lost in the cavity of the abdomen, and even parts of fœtuses after extra-uterine gestation or rupture of the uterus, may make their way to the surface and be discharged by abscess, or ulceration, or, penetrating the intestinal canal, may be evacuated per anum by a similar process. In cases of this nature, these bodies are inclosed within a sac composed of false membranes and adhesions, in such a manner as to be entirely separated from the general cavity of the peritonæum. Instances are on record of the escape by the rectum of arrow-heads, poignard-blades, musket-balls, &c. which had been deposited within the peritonæum. Knives, and other hard

irregular bodies, after being swallowed have occasioned inflammation and adhesion between the viscus in which they were arrested and the parietes of the abdomen, and have been discharged through fistulous orifices externally.

Nature being thus fertile in resources, it would be exceedingly improper to enlarge a punctured wound with the intention of searching for foreign bodies known to have entered the abdomen; for we can never be certain into what part of the peritonæal cavity they may have subsided, nor what viscera they may have penetrated. When, however, the extremity of the body is discoverable in, or immediately beneath the wound of the parietes, it should be carefully withdrawn.

In *penetrating wounds of the abdomen made by cutting instruments*, there is no difficulty in ascertaining the fact of the peritonæum being opened; for the finger may be introduced through the orifice, and the smooth internal surface of that membrane can, with ordinary discrimination, be distinguished. The question is often decided on simple inspection, by the protrusion of a portion of mesentery, omentum, or intestine.

These wounds may be simple, or complicated with a protrusion or with a lesion of some of the abdominal viscera. When simple, our first care should be to arrest the hemorrhage, if any divided superficial vessels are detected. The patient is then to be placed in that attitude which most completely relaxes the abdominal muscles, and the wound closed as speedily and accurately as possible. This can be generally effected by adhesive strips alone; and indeed the cases are rare which require the additional aid of the suture. Even incisions of several inches in length, complicated with protrusions, are constantly cured by these means, and when stitches have been employod after great operations on the abdomen, it has sometimes happened that hiccough, sickness, and other alarming symptoms have supervened, and could be alleviated only by removing this cause of irritation. Still it is well known that the presence of stitches passed through the peritonæum and abdominal parietes, do not always occasion material inconvenience. There are cases in which the suture must be used, and there are some epidemic states of the atmosphere, during the prevalence of which, its employment may be preferable, for reasons already mentioned. The objection urged by Mr. S. Cooper against the suture, that the stitches not unfrequently cut their way out by ulceration before they have accomplished their office, appears to us to be not a very valid one; for when no other evil consequence follows their introduction, this little additional extension of the wound is unimportant; the parts through which they make their escape generally heal behind as rapidly as they give way before them; and previous to their removal, sufficient adhesions are formed between the edges of the wound to prevent their retraction, and the purpose of the suture is in great degree accomplished. Still, the needle should never be resorted to, except under pressing emergency; and the necessity for its use will be less frequent in proportion to the manual dexterity of the surgeon in managing the adhesive strips and other dressings.

The edges of the wound being brought into accurate coäptation, the next step required is the application of a suitable bandage and compress, to give general support to the abdomen, to assist the action of the strips or suture, and to resist the tendency of the viscera to escape at the orifice. To accomplish these objects, it is generally directed that a flat compress should be applied over the simple pledget spread with cerate, which is laid upon the previous dressings. This compress is to be acted on by means of a bandage enveloping the whole abdomen.

The roller is here liable to obvious objection, as its application is difficult or impossible without inducing improper exertion, or change of position, on the part of the patient. Nor is the many-tailed bandage, as ordinarily prepared and employed in these cases, entirely free from inconveniences. The best apparatus for producing pressure on the abdomen, is a bandage of strips, so arranged as to overlap each other in two-thirds of their width, and stitched together by a seam along the middle of their length, which should correspond with the spinal column.

When a portion of omentum or intestine protrudes through the wound, it should be returned as speedily as possible, care being exercised to handle these parts as little and as gently as may be. If, as sometimes happens in extensive incisions, the protruding parts have dirt or any foreign matter adhering to their surface, this should be carefully removed by a stream of water gently warmed, or by the light touch of a soft sponge. If the wound is narrow, the surgeon should assure himself of the perfect reduction of the viscera by passing his finger within the peritonæum, and gently making it perform there a circular movement, so that the smooth internal sur

face of the membrane may be felt around the whole circumference of the incision; for it is possible that a portion of intestine may be lodged between the fasciæ of the abdomen, and thus remain without the peritonæum, while it is apparently returned into the cavity.

In straight incisions, it is rarely difficult to retain the viscera within the abdomen without the use of sutures; but when irregular or angular wounds take place, they are sometimes indispensable. In England and this country, the interrupted suture is generally employed; but in France, they prefer the quilled suture, and we think with reason. This suture is applied by means of two curved needles, threaded by a flat ligature, formed of several waxed threads, doubled upon themselves, so as to make a loop at one extremity. With each of these needles the abdominal parietes are punctured from within outward, at two opposite points, distant about six or eight lines from the edge of the wound. When a sufficient number of these ligatures have been passed, an assistant pushes together the divided edges, already relaxed by the position of the patient; the surgeon introduces a small cylinder of wood, linen, or waxed cloth into the loop presented by each ligature at one of its extremities toward the lower side of the wound, and after parting the threads of the other extremity of the ribbon, he ties them in a bow-knot over a similar cylinder on the opposite side of the wound. These ligatures are allowed to remain four or five days, unless some accident in the case requires their being removed sooner. (Marjolin, *Op. Cit.*) A simple ligature of waxed silk, of suitable thickness, is perhaps preferable, upon account of the small space which it occupies, and the readiness with which it can be procured at all times.

When a portion of intestine is protruded, together with a part of the omentum, it is laid down as a standing rule, that the former should be reduced before the latter, or, in general terms, that the part which protrudes last should be reduced first; and the propriety of this advice is obvious. This object is generally accomplished without much difficulty by acting upon the intestine with the two index fingers laid in the wound, either by a steady pressure exercised by both at once, or by the alternate action of each finger separately.

Difficulty may occur in our attempts at reduction, from several causes. In small wounds the protruded intestine may be so surcharged with its ordinary contents, or with air, as to make its return by simple pressure impossible; it may be strangulated, or in a state of inflammation, or it may have formed adhesions to the edges of the wound. In larger incisions, a spasmodic contraction of the muscles may diminish the cavity of the abdomen, and dilate the wound, so that the former can scarce contain the whole bulk of the viscera, and the edges of the latter cannot be properly approximated; there may also exist a general dilatation of the intestines by gas, which may render it difficult to inclose them within the parietes of the abdomen, even when free from spasm, as was observed by Dr. J. R. Barton in the case of the unfortunate girl murdered by Gross; and also in that of a patient upon whom he operated for the reduction of a strangulated inguinal hernia, several years ago. In the former instance, the bowels were returned without puncture; but in the latter, this was impossible, and Dr. B. made a valvular opening into the protruded intestine, which he effected with a bistoury. The air being evacuated, the hernia was reduced with ease. The external wound was closed by suture and compress; but on the succeeding day the gaseous secretion had again accumulated, and reproduced the protrusion. Finally, in defiance of all opposition, the intestine forced its way through the intervals between the sutures, and the patient died. No effusion had taken place in consequence of the puncture.

The embarrassments from inflammation, strangulation, and adhesion, occur also when the omentum alone protrudes. We will notice each of these causes of difficulty in succession.

When the protruded intestine is neither inflamed nor adherent, but refuses to return in consequence of the bulk of its contents, whether solid, fluid, or gaseous, it is sometimes recommended to withdraw an additional portion of intestine, in order to distribute the contents of the fold over a larger space, so that it may be more readily urged forward through the constricted orifice into the abdomen: the intestine, thus emptied of its contents, is generally returned with ease. In pursuing this plan, it should not be forgotten that an increased amount of mesentery is involved in the wound, so that if too much intestine is withdrawn, the additional bulk may increase instead of diminishing the difficulty of evacuating the protruded part. When the distension is occasioned by air, we cannot perceive

the advantage of the step just recommended; for if the protruded part is already so tightly grasped as to prevent the passage of so rare a fluid, it is hardly likely that anything short of the enlargement of the wound can facilitate the reduction.

Paré occasionally punctured the inflated intestine, in such cases, with a small needle; and Rousset, Garengeot, Sharpe, and Van Sweiten, recommend the practice; but when the puncture is made with a fine needle, the mucous coat closes the aperture almost immediately, and thus destroys its usefulness. Chopart and Dessault therefore recommended the employment of a large round needle; the use of such an instrument is perhaps still more objectionable, for the orifice may still be closed by the projection of the mucous coat, while the danger of inflammation is considerably increased. Boyer, Richerand, and Marjolin, limit the puncture for the evacuation of air to cases in which the enlargement of the wound is rendered inadmissible by some peculiarity in the circumstances; and when compelled to resort to this measure, they employ a fine triangular trochar, by means of which they are sure of accomplishing their object. A very delicate instrument would be best adapted to this operation; it should be flattened like that employed in paracentesis abdominis, and should be inserted with its edge in the direction of the length of the intestine; for the experiments of M. Travers show us, that transverse wounds of these parts are more serious than those which are longitudinal. Most of those who recommend puncturing in these cases, advise that a fine ligature should be passed round the intestine and through the mesentery at the point opposite the puncture, so that by drawing the ends of this ligature out at the external wound, we may keep the little opening in the viscus in contact with its edges, after the reduction has been effected: this is done in order to lessen the danger of extravasation; but the precaution is now generally held unnecessary. Marjolin thinks that if any fear of effusion is entertained, it would be better to seize the sides of the puncture with a dissecting forceps, and apply a delicate ligature, cutting off both the extremities close to the knot, as was successfully practised by Sir A. Cooper for a perforation of an intestine in a case of hernia. (*Op. Cit.*)

La Faye, Blancard, Sabatier, S. Cooper, &c. discard the plan entirely; and although we think that the dangers of so slight an operation have been exaggerated by some, it is difficult to conceive what circumstances can require the measure in question, except when a large portion of protruded intestine becomes dilated to such a degree that the parietes cannot be closed over it. Certainly it should never be practised when the reduction can be accomplished by the enlargement of the wound.

When the protruded portion of intestine is strangulated or inflamed, no time should be lost in enlarging the wound and reducing it. Venesection, both before and after the operation, is decidedly proper, when the inflammatory action is considerable. We must not hesitate to return the inflamed intestine, whatever may be the violence of the inflammation or the peculiarity of its colour, unless it is unquestionably in a state of gangrene: it may be dark red or almost black, yet if it retains its firmness, it should be returned; but if it be in a state of mortification, other modes of proceeding become necessary, which will be noticed under the heads of wounds of the intestines and artificial anus.

In enlarging a wound of the abdomen, it is generally recommended that the incision should be carried upward, as the danger of hernia is considered greater when the injury is seated near the lower part of the cavity. The instruments commonly employed are the probe-pointed curved bistoury, with or without the aid of a grooved director. While operating, the patient should be placed in the posture best calculated to relax the part, and the surgeon holding the intestine toward the lower part of the wound, with one hand uses the index finger as a guide to the bistoury or the director. If the latter can be introduced to the bottom of the wound without difficulty, the operation may often be performed at a single effort; but if this cannot be accomplished with facility, the aponeuroses, muscles, and skin may be first divided by successive retractions of the knife, the incisions being carried from within outwards, and as nearly as possible in the direction of the fibres. Care must be exercised to avoid the track of any considerable arterial branch, and that of the suspensory ligament of the liver, for reasons already mentioned.

When, in consequence of neglect or unavoidable delay, adhesions have been formed between the protruded parts and the edges of the wound, these should be divided, if possible, to permit the reduction to be accomplished. Great care is required in effecting this division, for we are compelled to carry the incisions in various directions. The probe-pointed bistoury is

generally considered as the best instrument in these cases; but it would be difficult to lay down very strict rules where the circumstances of the accident may vary so widely. If the adhesions are so firm that the intestine cannot be reduced, the case is still by no means desperate when the wound is large enough to prevent the danger of strangulation; for as CALLISEN has observed, the protruded viscus sometimes becomes covered by granulations, and a cicatrix is formed over it.

When the spasmodic action of the abdominal muscles opposes a barrier to the reduction of the protruded bowel, or prevents the closure of the wound, we must have recourse to the free abstraction of blood by venesection, and the internal exhibition of opiate remedies, until the spasm is conquered.

In very extensive wounds of the abdomen, enormous quantities of intestine may escape. One of the most singular cases of this nature is that related by Mr. HAGUE, surgeon at Ripon. The patient, a lad of twelve years of age, received a wound about four inches in length, on the left side of the body, commencing about two inches below the scrobiculus cordis. "The great arch of the stomach, and the whole of the intestinal canal, (duodenum excepted) contained within the abdomen," protruded. The stomach had been evacuated by vomiting. Mr. HAGUE proceeded to reduce first the stomach, and then the intestine, following the course of the canal. Some difficulty was experienced in preventing the exit of the reduced viscera, from the pressure of the diaphragm in breathing, that function being performed with much labour. Five sutures were employed, and supported by adhesive strips. The patient recovered. (*Ed. Med. and Surg. Journ.* V. 129.) In cases of this description, general inflation of the bowels may render reduction very difficult; but if due care is taken to contract the wound as the intestines are returned, and to preserve the edges in contact at one extremity, by the aid of an assistant, the object can be accomplished in almost every instance. As a last resort, if all other means fail, we may then puncture the bowel with the trochar mentioned above, introducing the instrument obliquely through the several coats, and allowing the gas to escape through the canula. The instrument should be so small as not to require the closure of the puncture by ligature to prevent effusion, of which the danger is fortunately less considerable than many surgeons have represented.

The intestines themselves may be implicated in the original wound; but this is not the proper place to treat of these very serious complications: they will be discussed under the head of Wounds of the Intestines. It is also unnecessary to repeat the proper consecutive treatment of wounds of the abdomen, that subject having been already enlarged upon in the preceding section on punctured wounds.

It has been stated that the omentum may be strangulated, inflamed, or adherent to the edges of the wound, when it protrudes without being followed by intestine. If no great difficulty opposes its reduction, it should be returned immediately; but if adhesions have taken place, there are two modes of proceeding recommended under different circumstances. If the protruded portion is small, and no unpleasant symptoms are present, we may cut it off to the level of the integuments, and leave the remainder to cicatrize with the wound: this is supposed to lessen the danger of subsequent hernia. When the protruded portion is larger, or when there exists a sense of dragging about the stomach, nausea, vomiting, or other symptoms of strangulation, the wound should be enlarged immediately and the reduction accomplished. To avoid the danger of lacerating the delicate omentum, it is best to dilate the wound from the lower angle when we have occasion to use the grooved director as a guide to the bistoury.

The omentum, when protruded from the abdomen, is sometimes attacked by gangrene. This condition is recognized by the clammy softness of the mortified part, by its colour, generally gray, but sometimes dead white, by its fetid odour, and by the discharge of a greasy fluid from its cells. In other cases, when this part is on the point of becoming gangrenous, it is hard, and of a deep-red livid colour; yet it does not bleed when cut. It was formerly advised that the gangrenous omentum should be included in a ligature placed above the dead portion; that the mortified part should be cut off, and the rest returned into the abdomen, the ends of the ligature being secured externally. This dangerous plan is now discarded; its grave inconveniences have been demonstrated by an observation of POITEAU, and by the experience of LOUIS and PIPELET. The proper mode of treatment in such cases is as follows: if the gangrenous portion is small, we leave it to nature; if it is voluminous, we examine it in order to assure ourselves that no fold of intestine is inclosed within it. The greater part of the

dead matter should then be cut off, with the scissors, in order to relieve the patient from the disagreeable odour, and the rest enveloped with a strip of linen, spread with cerate, or moistened with weakened liquid chloride of soda. The remainder of the eschar is detached in the course of a few days, and the healthy portion lying in the bottom of the wound, closes it, and contracts strong adhesions there. The wound may also be enlarged, and after having displayed the epiploon, we may remove the gangrenous portion, by cutting through the sound parts. The reduction should then be attempted, after tying, or applying tortion to the divided arteries. This last method has the advantage of preventing the dragging produced by the adhesion of the omentum to the wound; but it greatly enhances the danger of traumatic peritonitis and consecutive hernia. (MARJOLIN, *Op. Cit.*)

Gun-shot wounds penetrating the abdomen, when not complicated with similar injury to the organs contained within the cavity, seldom require any other treatment than the free use of local and general antiphlogistic measures. They are rarely followed by protrusion of the intestines; but the ball is not unfrequently lodged within the cavity or its parietes. Little aid can be afforded by the surgeon in cases of this character. The ball may subside, by its weight, toward the lower part of the abdomen, or into the pelvis; it may remain suspended among the convolutions of the intestines, surrounded by false membranes; or it may be lodged in the spine or muscles of the back or pelvis. In some cases the presence of the foreign body gives rise to no considerable inconvenience; but in other instances it excites violent inflammation, with purulent secretion into the cavity of the peritonæum; or produces a limited abscess which may be discharged either into the same cavity, or, as sometimes happens, into the alimentary canal. In the latter case, the patient may survive. M. MARJOLIN relates an instance in which one of these abscesses resulting from a contusion, opened at the same time into the small intestine and the bladder; a great quantity of pus, mingled with matter from the intestine, being evacuated by the urethra: this fistulous communication had continued many years when the patient consulted him.

The majority of cases in which gun-shot wounds involve the organs within the peritonæum, terminate in the death of the patients from effusion and the consequent inflammation, during the first few days after the accident. Even when this immediate danger is past, the effusion may still take place at a later period, on the separation of the sloughs: this last occurrence, however, is very rare, as it can only happen when the peritonæum has failed to form adhesions around the eschar.

The number of recoveries, notwithstanding the formidable dangers which surround these injuries, is very considerable; but for the details of cases and treatment, we must refer the reader to the articles headed *Intestines*, *Bladder*, *Stomach*, &c., where the diagnosis and surgical management of particular accidents will be discussed more fully than would be proper in this general sketch. REYNELL COATES.

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For the completion of this Bibliography the reader is referred to the articles on wounds of the several organs contained in the abdomen.

I. H.

§ 2. Contusions of the Abdomen.—Those contusions which affect the parietes of the abdomen without involving the viscera, are termed simple; but when the injury is extended to any of the organs contained within the cavity, the contusion is said to be complicated.

1st. *Simple contusions of the abdomen.* These are not very frequently dangerous, except when they take place in the lumbar region, or about the brim of the pelvis. The abdominal parietes are everywhere else so yielding and mobile, that the force of a blow is generally felt by the more delicate parts beneath, almost as strongly as by the integuments themselves; and the mischief which results, if it is very obvious externally, is almost always complicated. The position of the spinal column and the muscles attached thereto, renders the lumbar region so firm and resisting, that simple contusions upon this part may be attended with all the consequences of similar injuries in other situations; and parts in the neighbourhood of the brim of the pelvis are liable to suffer in like manner, because of the immediate proximity of the fixed attachments of the muscles and tendons, and the perfect facility with which the intestines beneath may escape by their mobility. Contusions about the lower ribs are scarcely ever simple, if at all severe; for the viscera in this region are more fixed, while the parietes, including the lower ribs themselves, are easily depressed by moderate forces. When, however, the abdominal muscles are in a state of strong contraction, their power of resistance is astonishingly great, and they are then capable of protecting the bowels against the effects of blows and weights which under other circumstances would be highly dangerous or fatal. We have seen a man who, by simply contracting the recti muscles, could endure, without being moved from his position, the most violent blows of the fist upon the abdomen just below the umbilicus. Some of the feats of the Ravelle family, lately exhibited in Philadelphia, and those of a man who formerly obtained great notoriety in London by lying down in the street and allowing carriages to be driven over his abdomen, are still stronger instances of this fact. When thus contracted, the muscles, or their tendinous expansions, may suffer very severe contusions without permitting the viscera to participate in the injury; and thus we may account for the many recorded cases of rupture, by external violence, of one or more tendinous expansions on the anterior part of the abdomen, of the recti, and of other muscles, unattended by solution of continuity either in the skin or peritonæum.

The treatment of simple contusions of the abdomen, when unattended with the rupture of any important fibres or vessels, should be conducted upon general principles, (see *Contusion*,) and it is needless to discuss it here. When considerable ecchymoses take place, they are generally found confined to a small surface when seated in the superficial cellular or adipose tissue, and much more widely diffused when located beneath the fascia superficialis: in the latter case, however, they spread less freely in the neighbourhood of the umbilicus, linea alba, and os coccygis, than in other directions. When the extravasation is seated between the peritonæum and the muscular walls of the cavity, it extends with great facility, not being arrested or confined by the edge of the pelvis, nor, entirely, by the linea alba. M. Velpeau (*Dict. de Méd.*) states, that in three cases of death from external violence, he was able to ascertain that it becomes more and more evident as it recedes from the umbilicus and the linea alba, in the middle two thirds of its length; and he refers to Pelletan, (*Clin. Ch.* Tom. II. p. 117.) for the case of a bricklayer, in whom the extravasation extended from the right lumbar region into the pelvis, and over the whole base of the left thigh. When blood is effused in this last situation, it generally lies concealed from observation; and the dull pain felt by the patient when attempting to rise, or to perform any movement whatever, with the sense of pressure and weight in the abdomen, are the only symptoms which present themselves. These, though they may lead to a suspicion of the nature of the case, do not furnish sufficient foundation for an accurate diagnosis, for they are equally characteristic of effusions within the abdomen, and may be present in injuries of a different character.

The aid of art is hardly ever demanded for the evacuation of these extravasations; they are for the most part absorbed with great rapidity, but they may remain for a very long time without occasioning serious inconvenience. It is only when they give rise to abscess, and when the symptoms of this change are unequivocal, that the question can arise whether they should be opened by the lancet. When the ecchymoses are very extensive; after the inflammatory symptoms have subsided under the usual treatment, the absorption may be sometimes accelerated by the

proper application of moderate pressure with a bandage, skilfully applied.

When severe—simple contusions of the abdomen are attended with danger of peritonæal inflammation, from the same causes which produce that complication in wounds of the abdominal parietes, (*q. v.*); and the same cautions recommended under that head are equally necessary here. The antiphlogistic treatment should be carried as far as the circumstances of the case will permit, whenever such danger threatens.

Although the parietes of the abdomen yield so readily to impinging bodies, that the viscera almost always participate in the injury inflicted by them, yet it is possible for rupture to take place in any of the muscles, tendons, or fascia, or even in the peritonæum itself, while the contusion still retains the character of strict simplicity, the skin remaining undivided and the bowels free from all lesions. One of the most frequent causes of such ruptures is the kick of a horse received upon the abdomen: J. L. Petit and Boyer each mention a case of the rupture of a hernial sac in this manner, without any material injury either to the integuments or the intestine; and Velpeau refers to another, in the thesis of M. Darbefeuille. Desault has witnessed the complete division of the peritonæum and other parietes, giving rise to a consecutive hernia which was covered by nothing but the integuments; and we have noticed a fact, similar in all respects, except in the integrity of the peritonæum, and in the rupture being situated a little above the right internal abdominal ring. The patient was a seaman on board the Factor, of Philadelphia: he received a slight kick from a horse on the Course at Calcutta, which did not disable him from pursuing his usual occupations: after a short time, however, a small hernia made its appearance; and once, on the homeward-bound passage, the intestine was near being strangulated, a very unusual danger in injuries of this character. M. Thomas, in his thesis, mentions a rupture of the rectus muscle, not extending to the peritonæum or the aponeurosis; and Larrey has seen all the broad muscles thus divided near their insertion into the crista ilii. It has been supposed that in these ruptures, and severe simple contusions, the extent of the external injury and the safety of the viscera may sometimes result from there being no internal organ placed between the impinging body and the projection of the spinal column at the moment of the accident. To this idea we cannot subscribe; for if a blow be inflicted by a body small enough to depress the parietes to so great an extent, while it could thrust aside, without bruising, the convolutions of the intestines, it must necessarily act like a cutting instrument, and the integrity of the integuments could not be preserved; unless, indeed, in an extremely emaciated patient. We are inclined to think that in all severe simple contusions of the abdomen, the contraction of the muscles at the moment, prevents the depression of the parietes; and that ruptures, when they occur in the muscular parts, are owing as much to spasmodic contraction, as to the direct action of the external force. (See *Ruptures of the Abdomen from Internal Causes.*)

These cases of simple contusion attended by ruptures, like those of incised and lacerated wounds, are often liable to consecutive hernia, which should be prevented, if possible, by the use of a belt so contrived as to produce firm support over the injured part. This should be applied as soon as the inflammatory symptoms have subsided, and continued until some time after the union of the divided parts is complete, or until the new bond of union has had time to contract and condense itself.

2d. *Complicated Contusions of the Abdomen.*—These may involve a great variety of injuries to the abdominal or pelvic viscera, in which, any one, and often, several, of the organs may be implicated.

One of the most frequent complications results from the general pressure upon the nerves and other contents of the cavity, produced by the contusing force; and this subject has not elicited a degree of attention commensurate with its importance. It is by no means uncommon to observe, in patients who have been bruised by the action of large and heavy bodies, and particularly in workmen who have been partially buried in making excavations, a state of general depression, or collapse, altogether disproportioned to the severity of the injury inflicted upon any particular part or organ, and which cannot be explained upon any other supposition than that the splanchnic nerves have had their functions more or less completely suspended by the compression to which they have been subjected. In such cases, costiveness and retention of urine are generally observed; the former being attributed to the loss of tone in the abdominal muscles, which no doubt contributes in some degree to its production; but the latter symptom has been singularly neglected by surgical writers. When the compression has not been violent or long continued, the organs

soon regain their natural powers, moderate reaction speedily ensues, and the case may terminate favourably in a very short time; but when the reverse of this happens, the loss of tone continues for a considerable time; and if the bladder is not evacuated by artificial means, the urine accumulates continually, and the viscus becomes completely paralyzed by distension, giving rise to a very serious, and perhaps fatal, complication. This retention of urine is not accompanied by any considerable pain; and the uneasiness is generally referred, both by the patient and surgeon, to the contusion of the organs contained within the abdomen. We have seen, on several occasions, the bladder distended almost to bursting, when no such state of things had been suspected until the long-continued absence of the discharge induced the surgeon to examine the hypogastric region. It is highly important, then, to attend to the condition of the bladder in all cases of contusion or strong compression of the abdomen. Dr. Parrish of this city has for many years called the attention of his class to this subject, in the course of clinical remarks at the Pennsylvania Hospital.

The same species of paralysis in contusions of the abdomen sometimes occurs in falls, from considerable heights, upon the lumbar region, and is then due to concussion of the spinal marrow, or the origins of the spinal nerves. This effect may be evanescent, or it may last for several days. We give one mild case in illustration. W. T., a lad on board the Factor Indiaman, when at sea, in November, 1823, slipped and fell backward down the booby-hatch, striking the upper part of the lumbar region strongly upon the edge of his sea-chest. He was at first unable to rise, but in a few minutes succeeded in reaching his berth. His lower extremities were somewhat enfeebled; but in the afternoon, he was able to walk without much difficulty. The bladder was somewhat distended, and he was directed to endeavour to urinate. He discharged a few drops with great difficulty, and apparently by strong effort with the abdominal muscles. As the other symptoms were rapidly declining, it was supposed that the bladder would soon regain its power of contraction. On the following morning the distension was so great that the fundus of the bladder rose nearly to the umbilicus; but as the boy was on deck, and apparently well, with the exception of weakness, no particular inquiry was made until near the middle of of the day; and it was not until he complained of an involuntary discharge of urine, guttatim, that this distension was discovered, and the catheter introduced. The bladder was found to be so completely paralyzed by the enlargement, that its contents were not entirely evacuated without the aid of pressure. In a few hours, the catheter was withdrawn, and the bladder was found to have regained its power. The patient complained of no considerable inconvenience except from the presence of the instrument. The ordinary measures for relieving retention of urine are here obviously inapplicable, the difficulty depending not upon an irritation, but upon a suspension of the nervous power. Our sole trust is in the catheter, which should be introduced, repeatedly if necessary, until the proper tone of the organ is regained.

Contusions of the abdomen, complicated with peritonæal inflammation, injury of the kidneys, rupture of the ureters or urethra, or fractures of the pelvis, are also attended with retention of urine, or the arrest of the secretion of that fluid; each of which accidents will be considered in its proper place. But although most of these causes are followed by more severe nausea, vomiting, and rigors, than attend upon simple compression or concussion, they may all act consentaneously with the latter; and it should therefore be considered as a standing rule, that *the condition of the bladder must be examined in every case of these contusions, unless the patient discharges urine freely, within a reasonable time after the accident.* One of the most dangerous consequences of contusions of the abdomen, is the traumatic peritonitis, which, when general or severe, frequently terminates in death before the expiration of forty-eight hours from the time of the accident. It is needless to repeat in this place the directions given for preventing or combating that most formidable complication; but it may be well to remark, that peritonitis may exist in full violence, producing universal adhesions among the bowels, and the secretion of pus; it may run its career, and terminate mortally, while the countenance continues shrunk and pale or livid, the muscular system relaxed, the pulse nearly or quite imperceptible at the wrist, and everything indicating a profound collapse. It is not even necessary that the viscera themselves should be seriously injured, in order that this inflammation should be produced. Velpeau quotes a case from the thesis of M. Penasse, in which the abdominal muscles were the

seat of extensive extravasation, and the patient died of peritonitis. (*Dict. de Méd.* Art. *Contusions de l'Abdomen.*)

The vigorous antiphlogistic treatment, so imperiously demanded in this complication, would prove highly dangerous, or fatal, in simple concussion, or loss of power from pressure; and the stimuli resorted to, in severe cases of the latter, by many practitioners, a practice which, under all ordinary circumstances, should be followed with great caution, would be equally dangerous in the former. The diagnosis, in these accidents, is often difficult; but the collapsed condition is generally attended with little absolute pain; and although vomiting, or nausea, commonly occurs immediately after the infliction of the injury, it is seldom continued or repeated. The pulse, when perceptible, is neither very rapid nor contracted. The reverse of this is true in the majority of cases of traumatic peritonitis; and the countenance, which is languid but calm in simple concussion, wears a painful expression in the inflammatory affection.

The abdominal viscera are liable to contusions in all respects similar, and quite as various, as those which are met with in the parietes. Thus, extravasations of blood, precisely resembling those already described, take place beneath the peritonæal covering of those organs, or within their substance. Velpeau has met with them on the convex surfaces of the liver and spleen, and in the thickness of the coats of the stomach and intestines; Morgagni has collected numerous cases of the kind in his 44th Epistle; and Jobert cites a case of a man whose intestines were covered with ecchymoses. Partial ruptures by external violence, not interesting the whole thickness of the organ, have also been observed. M. Penasse has seen the rupture confined to some of the coats of an intestine without involving others. (Velpeau, *Op. Cit.*)

Though every abdominal organ may be the seat of contusion, those are most likely to suffer which are most solid, fixed, and superficial; and first in rank in this class, is the liver. This organ must necessarily suffer compression and injury in all severe blows on the right hypochondrium, and inflammation is frequently the consequence, even in slighter cases, (see *Hepatitis*); but from its friability, it is often torn or ruptured by blows, falls, or pressure, and an internal hemorrhage results, which is beyond the reach of surgery, and too frequently terminates fatally. A diseased condition, or enlargement of the liver, may increase the danger of this accident. The rupture may occur at a distance from the spot upon which the blow is struck, owing to the doubling or bending of the liver under the pressure of the force applied, or it may result from the momentum acquired by the viscus in falls from a considerable height; the extensibility of the abdominal parietes allowing the suspended liver to double or fold upon itself, or to break in part from its attachments. M. Penasse saw an instance at the Hotel-Dieu, in which the rupture took place on the concave surface; M. Forget met with two instances, in one of which, the liver of a patient with intermittent fever was torn in many places on the convex surface, in consequence of striking the abdomen forcibly against a bench; in the other, a triple rupture was occasioned by a blow of the fist. We have examined two cases of similar injury upon the concave surface, and one of fissure near the coronary ligament, all consequent upon falls from great heights, and unattended with injury to the parietes. In the two former, the hemorrhage was not very great, nor the lacerations deep, but the patients died of peritonitis; in the other, there was a fracture of the base of the skull, and the death was nearly instantaneous.

Numerous instances are on record of rupture of the *gall bladder* by similar causes; an accident of the most hopeless character.

The *spleen*, though smaller than the liver, is liable to similar changes from disease; it is subject to contusion and rupture from like causes, and these accidents are attended with the same dangers of inflammation and effusion. In common with those of the liver, the ruptures of this organ are generally fatal; but when slight, recovery may take place without our being assured of their existence. Cases of this accident are recorded by Morgagni, (*Epist.* 54, in which numerous cases are also quoted from the older writers,) Chisholm, (*Edinburgh Med. & Surg. Jour.* VIII. 257,) Hennen, (*Military Surg.*) &c. Two cases are also quoted in the *Am. Jour. Med. Sc.* VII. 549, and VIII. 223.

The *kidney*, although so much smaller and so deeply seated, is liable to contusions and lacerations of the same nature, as the annals of surgery amply testify. When a rupture of the kidney communicates with the peritonæal cavity, the patient is sometimes, though rarely, subject to all the dangers of effusions of blood or urine in that situation; but when the peritonæum

retains its integrity, and the effusion occupies the cellular tissue, the case is much less grave in character.

Rupture of the *urinary bladder* from contusions of the abdomen, though somewhat rare, have been observed and narrated by several authors. Bonetus in the *Sepulchretum* relates a case; another is given by Dr. Fix, of Berne, (*Bull. de Ferussac*, II. 167.); three by M. Delarue, (*Journal Hebdomadaire*, 1830); one by M. Hourmann, (*Clin. des Hôpit.* Tom. I. No. 14); one by J. Cloquet, (*Ibid.* Tom. II. No. 22); two by Dr. Cusack, (*Dub. Hosp. Rep.* II. 312); and four others were reported to M. Velpeau, from the wards of the Hotel-Dieu under Dupuytren. (*Dict. de Méd.* Art. *Abdomen*, *Contusions de l'.*) This accident is regarded as necessarily fatal, when the laceration includes the peritonæum. It is considered necessary that the bladder should be in a state of distension at the moment of the injury; and although one of Dr. Cusack's patients assured him that he had evacuated his urine a short time before the laceration took place, his account was not credited.

The *uterus*, like the bladder, when empty, is not liable to participate in the contusions of the abdomen; but when enlarged in gestation, it enjoys no farther immunity than that which results from the caution of the female and her friends in guarding her against accidents during that period. Ruptures of the uterus from external violence are comparatively rare, but they have been observed in many cases: they are not always fatal, notwithstanding the dangers of terrible hemorrhage, and of the escape of the liquor amnii, or the fœtus itself, into the cavity of the peritonæum.

The whole length of the alimentary canal, from the stomach to the colon, is liable in every part to contusions from external injuries, which may occasion extravasations within the proper coats, violent local inflammation, gangrene, or rupture, against which the mobility of the intestines does not appear to protect them. Such ruptures of the stomach are not common. One such case fell under the observation of Portal, (*Anat. Méd.* V. 202.) and another was witnessed by M. Roques, (*Jour. de Sedillot*, Tom. 65.) Portal's case resulted from a fall in a drunken fit; the patient struck his abdomen on the ground, and died in four hours. No ecchymosis was observed, nor was there any external contusion. Ruptures of the intestines, both small and great, have been very frequently noticed, even without any visible signs of injury externally; they have been sometimes completely divided by a blow from a stick, a kick from a horse, and other similar causes, without the integrity of the skin being impaired. Numerous cases of this character will be found in the writings of Haller, Fabricius Hildanus, Bonetus, and Morgagni, and in other more recent annals. References to the 54th *Epistle* of the latter, to the cases of Tod, (*Dubl. Hosp. Rep.* I.) Speer, (*Ibid.* IV. 349,) Drake, (*West. Med. & Phys. Jour.* Jan. 1828,) will present a view of most varieties of this accident. The danger of severe contusion or rupture is of course greater in proportion to the quantity and solidity of their contents at the time of the accident.

Contusions of the abdomen may be complicated, even with rupture of the great vessels, without abrasion of the skin. In these cases, the intestines are so thrust aside by the impinging body, that the yielding and flexible parietes may be brought nearly into contact with the spine, so as to permit these vessels to be torn. The *vena portarum*, *vena cava*, and *aorta*, have all been ruptured in this manner. Bonetus, (*Sepulc.*) S. Grass, and Preussius, (*Eph. N. C.* Dec. 3. Art. 2, 5 & 6.) M. Breschet, (*Dict. de Sc. Méd.* Art. *Déchirement*,) and M. Richerand, (*Nosog. Ch.*) have all described accidents of this nature. These terrible and fatal complications result from heavy blows, the pressure of great weights, or the passage of wheeled carriages over the abdomen, and can scarcely be produced by slighter causes, such as may be sufficient to produce rupture or severe contusion of the viscera.

When contusions of the abdomen extend to the viscera without producing rupture of any organ, the most immediate consequence which calls for the attention of the surgeon, is the inflammation of the injured part; but as the symptoms and treatment vary with the situation of the lesion, we refer the reader to the articles treating of each particular organ for all details. The necessity of employing with vigor the measures best calculated to lessen the danger of peritonæal inflammation, such as absolute repose, the abstraction of blood, low diet, warm bathing, and emollient applications, is not less pressing in this species of accident than in penetrating wounds of the same parts. One disposition is commonly observed in all contusions of the abdominal viscera unattended by rupture; namely, the tendency to adhesion between the injured surfaces and the neighbouring portion of the parietes. When the occurrence of general peritonitis is prevented, even for a short time, these adhesions sur-

round the site of the contusion, and remove the danger of that complication. When the vitality of a portion of the intestinal canal is destroyed by the blow or force applied, a slough separates, and the contents of the intestine may be poured out into a sac or chamber formed by false membranes, or they may be evacuated by fistulous openings into another viscus, or through the parietes of the abdomen; but if the surrounding adhesions are completely formed, the cavity of the peritonæum is almost always safe from the effusion. (See *Effusions into the Abdomen.*)

REYNELL COATES.

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I. H.

§ 3. RUPTURES OF THE VARIOUS PARTS CONSTITUTING THE ABDOMEN, FROM INTERNAL CAUSES.—Every part of the abdomen is occasionally the seat of rupture from internal causes; thus, the intestinal canal, in all its parts, may be torn by its own contents, when surcharged, or weakened by disease. The rupture may be complete or partial, involving all the coats, or either of them separately, perhaps with the exception of the mucous coat, which is everywhere redundant. (Vide *Stomach, Intestines,* &c.) ROSTAN has frequently observed the peritonæal coat torn, in women advanced in life and affected with constipation. MARJOLIN has seen the same effect produced by strictures, either permanent or spasmodic, and VELPEAU has observed both the peritonæal and muscular coats divided in this manner.

The gall bladder, the urinary bladder, and the uterus, are liable to similar accidents from like causes; and all the abdominal vessels, whether arterial or venous, are also subject to being burst in aneurismal or other enlargements.

The abdominal muscles are all liable to spontaneous rupture, but the recti are more frequently broken than any other of the large muscles. The efforts exerted during parturition have occasioned this accident several times; an instance of this has been published, by CHAUSSIER. (*Procès-verbaux de la maternité,* annè 1809.) Efforts in vomiting during gestation have also given rise to the same disaster. It takes place, likewise, with great facility, in patients affected with dothinenteritis or with typhoid fevers. At the hospital at Tours in 1819, it occurred in the case of a soldier who died on the thirty-seventh day of the attack. (VELPEAU, *Dict. de Méd.* I. p. 166.) The fragility of the muscles in the latter stage of putrid fevers, and the general diminution of the cohesion in muscular parts, in women of advanced age who are disposed to obesity, are causes which, according to the author just quoted, increase the frequency of such ruptures under these circumstances. The recti generally give way below the umbilicus, because they are there smaller and have fewer aponeurotic intersections.

The great distension resulting from the enlargement of the uterus during pregnancy, and the accumulation of water in ascites, abdominal tumours, &c. frequently produce a widening of the areolæ of the aponeurotic expansions, accompanied with the rupture of some of the tendinous fibres, and may occasion consecutive hernia when the rupture is unusually large.

Those injuries which are commonly termed sprains of the back, and which are so often caused by violent efforts in lifting, or by sudden twisting of the spine, not unfrequently result from the rupture of some fibres of the great muscles connected with the lumbar vertebræ. The nature of the accident is sometimes rendered obvious by the position of the ecchymoses, or by a depression of the integuments at the spot corresponding with the fissure.

Ruptures of the abdominal muscles produce a disturbance of those functions which depend, in part, upon their action, such as the alvine or urinary evacuations, respiration, &c.; and when neglected, they may give rise to more or less extensive ventral hernia.

The proper *treatment* for these accidents consists in regulating the position of the patient, so as to relax the injured muscle as completely as possible; the observance of strict repose; warm emollient applications; general, and more especially local, bleeding, preceded, when the pain is very severe before inflammation or fever supervenes, by local bathing with opiates, and perhaps the exhibition of laudanum internally; and followed, after the subsi-

dence of those symptoms, by resolvents, and the use of a belt to prevent the occurrence of hernia. When the rupture is deeply seated in the lumbar region, and when pain and weakness indicative of long-continued chronic irritation are present, it is sometimes proper to employ blisters, or even issues. When the torn ends of the muscle are preserved nearly in contact, they unite; and the gradual contraction of the fibrous bond of union restores their functions in nearly their original perfection.

Even the skin itself, and the whole thickness of the abdominal parietes, have been known to give way under the distension produced by ascites—but these very rare and fatal cases are not essentially different from lacerated wounds, and need not be considered in this place.

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§ 4. EFFUSIONS INTO THE ABDOMEN.—In consequence of various diseases and accidents, a great variety of fluid or even gaseous matters may be effused into the cavity of the peritonæum. In addition to the contents of any of the viscera, such as the stomach, intestines, bladder, &c., and that of the blood-vessels, whether of the general or portal system, the sero purulent secretion of peritonitis, the serous or gelatinous fluids of ascites and hydatids, the matter of various tubercles, and the aëriform secretion of tympanitis, &c., are all found in the same situation.

In this article we shall confine ourselves strictly to the consideration of those effusions which result from wounds and contusions, referring to the appropriate general heads, and to the articles on particular organs, for information on those which result from diseased actions which are beyond the jurisdiction of the surgeon.

1st. *Effusions of Blood into the Peritonæal Cavity.* These may take place from a great variety of causes, such as penetrating wounds, severe contusions, ruptures of the omentum, liver, spleen, intestine, or any other abdominal viscus; and the blood may be derived from any vessel, either located within the abdomen, or distributed to its parietes; for it is not unusual to observe a vessel opened by a punctured wound, discharging its contents internally when the external wound is narrow and obstructed. These effusions also occur from aneurismal or varicose enlargement of the arteries or veins within the abdomen: the annals of pathological anatomy are rich in such cases.

The exit of blood from the injured vessels, in these accidents, does not occur with as much facility as external hemorrhage; for the abdomen, as already observed, though called a cavity, is really a plenum: no considerable quantity of blood can therefore be effused into it without producing a compression of the viscera, or a distension of the parietes, which press upon the intestines by the tonic action of the abdominal muscles. J. L. PETIT, who was the first to attach much importance to this fact, thought that the resistance thus occasioned prevented the effused blood from subsiding to the lower part of the abdomen or pelvis, and occasioned it to remain, as indeed it generally does, immediately behind the external wound or contusion, the first portions which escape being thrust aside, and spread in a circle around the divided vessel, by those which succeed. GARENGEOT, on the contrary, contends that, notwithstanding the resistance opposed by the parietes, which retards the flow, the blood, when once extravasated, yields to the influence of gravitation, and subsides toward the most dependent part of the abdomen, while the action of the intestines rejects it from among the convolutions, and drives it toward the surface. PETIT attributes the dispersion of the effusion so frequently noticed in examinations after death, to the effect of accidental blows, and the handling and incisions necessarily employed in opening the body.

Mr. JOHN BELL, (*Discourses on Wounds.*) whose admirable labours often lose a portion of their value, in consequence of his fondness for general laws and his neglect of the exceptions, coincides to the fullest extent with PETIT, and the majority of modern surgeons agree with him. SABATIER, on the contrary, (*Méd. Op.* Tom. I. p. 28.) seems to lean to the opinion of GARENGEOT; and VELPEAU declares, that "neither of these explanations is absolutely true, nor absolutely false. Their common fault is, that they mutually exclude each other." (*Dict. de Méd.* I. 183.)

That the effused blood generally remains coagulated in the immediate neighbourhood of the ruptured vessel, and external to the intestinal convolutions, is sufficiently proved by the testimony of PETIT, JOHN BELL, &c.: that it yields frequently to the laws of gravity, collecting in a mass about the hypogastric region, or in the pelvis, is clearly shown by some of the cases cited by SABATIER, PELLETAN, &c.: and that it occasionally becomes diffused, even in a direction contrary to its gravity, and between the intestinal convolutions, is distinctly proved by several authentic records,

among which, one of the most remarkable is the second case narrated by PELLETAN, (*Clin. Ch.* II. 106.) in which the effusion took place from an aneurism or varicose condition of the ovary, and yet all parts of the peritonæum were found studded with the partially absorbed and condensed remains of old coagula, produced by a long-continued, but slow, exudation from the diseased organ. Those who desire to see more numerous proofs of the exceptions to the general law established by PETIT, and so warmly defended by J. BELL, may consult, in addition to the works already quoted, RAVATON, (*Plaies, &c.* p. 498.) VALSALVA quoted by MORGAGNI, (*Ep.* 54—15.) CABROLE, (*Obs. Variæ.* p. 100.) VACHER, (*Mém. de l'Acad. Roy. de Chir.* Tom. II.) GARENGEOT, (Ibid. Tom. II.) and PELLETAN, (*Clin. Ch.* Tom. II.)

The wide discrepancy of opinion on this subject appears to have resulted from a neglect of the equality of hydrostatic pressure established throughout the abdominal cavity. The intestines are everywhere in contact with each other and with the parietes; there exists no void; but they are lubricated by the peculiar secretion of the serous membranes, which surrounds them on every side, preventing all cohesion; thus, they remain as if suspended in a fluid. As they are completely flexible, and yield or change their position on the slightest application of force, the tonic pressure of the abdominal muscles acts equally in every direction upon their whole mass. Consequently, however this pressure may tend to oppose the flow of blood from a wounded vessel, it cannot have any very material influence upon the position assumed by a fluid already effused, but leaves it free to obey the laws of gravity, precisely as the serum poured out in ascites is observed to do. Now, if blood, when effused into the abdomen, does not always descend toward the pelvis, or rise toward the diaphragm, according to the excess or deficiency of its specific gravity when compared with that of the intestines and their contents, we must seek for the explanation of the fact, not in the tonicity of the abdominal muscles, or the incompressibility of the intestines, but in the properties of the blood itself. The specific gravity of blood generally differs but little, sometimes not at all, from that of the small intestines with their contents viewed as a mass; it is not a perfect fluid, being composed of solid particles, of an appreciable size, united to a liquid which cannot be separated from it by mechanical means; it is viscid, and adheres even to the moistened surface of the peritonæum while in the fluid state; and by coagulation it is speedily converted into a solid which adheres pertinaciously to all living tissues. Hence, gravity which tends to displace blood when effused into the abdomen is weak, while the causes which oppose that displacement are often more than sufficient to counteract its influence.

These plain physical facts are sufficient for the explanation of the various appearances observed by the several writers to whom we have made reference. When the wounded or injured vessel is small, and the blood escapes slowly, it soon coagulates, more especially if it flows from an artery, for the venous blood undergoes this change somewhat less rapidly. Its natural adhesiveness retains the extravasated blood in the immediate neighbourhood of the wound, and each succeeding portion applies itself to that which has already become solid, until the vessel is closed in the usual way, first by a coagulum external to the vessel, and adhering not only to the orifice, but also to the neighbouring peritonæal surfaces. Its serum is generally absorbed as it is ejected, and re-enters the circulation. When the quantity extravasated is larger, particularly if it coagulates tardily, its distribution depends in some degree upon the condition of the bowels and their contents: when their specific gravity nearly coincides with that of the blood, the latter diffuses itself on every side, forming a mass at the injured part, surrounded by a thin layer over the surface of the neighbouring convolutions, agreeably to the views of PETIT and J. BELL. When, as is often the case, the blood gravitates with more force than the intestine, it subsides, in part, toward the lower portion of the abdomen or into the pelvis, as GARENGEOT, SABATIER, VELPEAU, &c., assert: finally; when the small intestines with their contents are remarkably heavy, the effused blood may even display a tendency to rise, as in the case of ovarian hemorrhage narrated by PELLETAN.

In a vast majority of cases, if not in all, there remains a considerable amount of blood, coagulated about the seat of the injury, and the remainder only, experiences a change of place from the power of gravity.

The presence of effused blood in the peritonæum is not commonly productive of much irritation, unless the quantity is large: inflammation rarely follows in cases of this character. The serum is generally absorbed nearly as fast as it separates, and the coagulum itself gradually disappears in the same manner, although it frequently

requires a great length of time to remove considerable masses. Pelletan discovered distinct traces of old effusions, in one instance, twenty years after the accident which occasioned it. (*Clin. Ch.* Tom. II. p. 108.)

Nature does not always trust to the adhesion of the coagulum alone, to prevent its displacement and to effect its absorption. Even in the simplest cases the contiguous surfaces of the peritonæum sometimes adhere or coalesce, as Velpeau has remarked; but more generally, coagulable lymph is thrown out, false membranes are formed, and the remains of the effusion become regularly encysted. The blood, thus inclosed, is absorbed by the parietes of the sac, or, as sometimes happens, it becomes decomposed and gives rise to an abscess. "In short," says Velpeau, "it is not unusual to observe the blood to become altered, to resume its fluidity, to be transformed into a putrescent heterogeneous liquid, altogether unfit to re-enter the general circulation, and quite as dangerous to other parts of the system. While this dissolution, this chemical liquefaction, is effected, the parietes of the sac mingle with it an exudation, sometimes of a serosity more or less troubled, sometimes of pus with all its characters; which transforms the cavity into a sort of encysted dropsy, or converts it into a proper abscess." (*Op. Cit.*)

Something in the action of the intestinal convolutions appears to render difficult the accumulation of blood between them; for though coagula are occasionally met with in this situation, the occurrence is rather rare. The most considerable effusions are ordinarily found about the lower and lateral parts of the abdomen, or beneath the hypogastric region, where the sac is formed in part of the peritonæum lining the parietes of the abdomen; but when they are concentrated near or above the umbilicus, on the concave surface of the liver, or in the posterior part of the cavity, it is obvious that the cyst may be formed of the omentum, mesentery, and the peritonæal coats of the viscera unconnected with the parietes. Should the effused blood degenerate, the abscess in the former case tends to point externally, and the aid of the surgeon may be employed to give it egress; in the latter, the contents may be discharged by ulceration into the stomach or intestines; but it is obviously impossible to puncture the sac, without again involving the patient in the danger of effusion into the general cavity of the peritonæum, which must be traversed by the lancet before it can reach the abscess. Too frequently this consecutive effusion occurs by the bursting of the cyst before any outlet is formed, and the consequences are of course fatal. Though the effusion of blood is seldom attended with any considerable irritation to the peritonæum, an opposite effect is occasionally produced; general peritonitis is induced, and the patient sinks in a very short time.

The primitive symptoms of these effusions, when the hemorrhage is inconsiderable, are not sufficiently marked, to awaken much attention; nor is this a serious inconvenience, for the general treatment required in all wounds or contusions of the abdomen is precisely that which is best adapted for checking the discharge of blood in such cases. On the contrary, when a vessel of considerable size is injured, and a free internal hemorrhage results, there is little difficulty in determining the nature of the accident. The general symptoms of hemorrhage, such as paleness, languor, and feebleness of the pulse, may all be present, it is true, in cases of simple concussion and in other injuries unattended by rupture of a blood-vessel: pain, and the disposition to vomit, usually ranked among the peculiar symptoms, are common attendants upon injuries of the intestines, and effusions of a different character: but when any or all these symptoms are accompanied with a constant desire to urinate, and a sense of weight in the pelvis, or about the hypogastric region; when there is an obvious distension of the abdomen, accompanied by a respiration more or less embarrassed; and when these affections supervene soon after the occurrence of the accident, there can be little doubt that an extensive extravasation has taken place. When the patient faints repeatedly, especially if his consciousness does not fully return in the intervals, the case is rendered almost certain.

It often happens that effusions take place to a sufficient extent to produce serious consequences in the sequel, without the unequivocal presence of any of the signs just enumerated; and in all cases of doubt, the employment of mediate percussion with the pleximeter can hardly fail to render distinct, not only the existence, but also the position, of the effused blood, unless the quantity is very small.

If the patient escape the danger of a speedy death from the excess of hemorrhage, he may continue to suffer much inconvenience from the weight of the coagula and the displacement of the viscera;

but in most cases, the quantity of blood is not sufficient to produce this effect, and he continues calm, the effusion producing little or no inconvenience for several days. This state of things may continue permanently, the blood being slowly absorbed and no symptoms of inflammation supervening. When consecutive peritonitis or visceral inflammation occurs, it generally makes its appearance from the fifth to the tenth day, less frequently at a later period, and rarely earlier. If the fifteenth day passes over without serious accident, the patient, according to J. Bell, may be considered safe. (*Op. Cit.* D. 4. p. 96.)

Fever then comes on, ordinarily exacerbated at night. It is often preceded by a chill, and terminates by an irregular sweat. Pain, increased upon slight pressure, is felt in one or more points on the abdomen, inducing the patient to incline toward that side. Greater hardness, tension, and even somewhat more warmth, is perceived in this part. These symptoms, which mark the softening of the coagulum or its conversion into an abscess, are combined with loss of appetite, nausea, thirst, constipation or diarrhœa, derangement of the urinary, genital, or hepatic functions, &c., according to the region of the abdominal cavity occupied by the effusion. (Velpeau. *Op. Cit.* I. 195.)

For the future, the progress of the case does not differ very materially from that of common abscess similarly situated, except in the somewhat greater danger of inflammation in the neighbouring parts, from the putrescent properties of the contents of the sac. Of those instances, unfortunately too frequent, in which the effusion of blood produces general peritonitis, either primary or consecutive, it is unnecessary to speak in this place. (See *Abdomen, Wounds of the*—and *Peritonitis.*)

The *treatment* of effusions into the abdomen is now conducted upon much more correct principles than formerly; and the punctures for its evacuation, practised by many distinguished surgeons of the last century, are at present only resorted to with extreme caution, and never, until the surgeon is assured of the formation of a perfect cyst around the extravasated blood. It is now understood that the evacuation of the blood before its coagulation increases the danger of a fatal hemorrhage, without effecting any corresponding relief; and instead of promoting the external discharge of the blood, in penetrating wounds, we now confine it, by closing the orifice.

To disturb the coagula, when formed, at an early period would be equally improper, for these are the proper bars to the continuance of the hemorrhage. Fourcade, according to Velpeau, narrates a case in his thesis, in which the injured vessel remained so long unobliterated that a secondary hemorrhage took place on the fifteenth day. There is, moreover, no necessity for hasty interference in these cases: the dread of effused blood acting as a foreign body has been exceedingly diminished, even since the days of John Bell.

During the continuance of the hemorrhage and the days of calm which succeed, the patient should be kept in the most complete repose of body and mind, and the usual treatment, both general and local, employed in other hemorrhages, should be rigorously pressed. Larrey and Fourcade lay great stress upon the employment of cups and scarification in these accidents, and the application of cold to the part is highly important. "In following this course," says Velpeau, "if the effusion is not mortal in its nature, we almost always triumph."

If threatening consecutive symptoms supervene, the antiphlogistic treatment must be carried to the extent demanded by the urgency of the danger; and when it is obvious that the effused blood has undergone decomposition, or that the cyst is converted into an abscess, the question arises whether it is proper to puncture the cavity and evacuate its contents. By turning to the several authorities to whom reference has been made above, especially Cabrole, Garengeot, Vacher, Petit, and Pelletan, the reader will find a sufficient number of cases in which this operation has been successfully performed: but of latter years it has been almost discarded by the majority of surgeons. It is true that nature generally determines the evacuation of these cysts, either externally, or into some part of the alimentary canal; but it is equally true that the abscess may burst from very slight causes, and pour out its contents into the peritonæal cavity, as happened to a patient of Petit while actually on his way, in a wheeled carriage, to undergo the puncture. (*Mém. de l'Acad. Roy. de Méd.* V. 18. O.)

While shunning, on the one hand, the recommendation of Garengeot, that we should puncture, whenever the consecutive symptoms convince us of the existence of a quantity of effused blood in the abdomen, on the other, we cannot coincide with Cruveilhier, (*Essai sur l'Anat. Path.* Tom. I. p. 215.) in stating that the

sac should never be punctured except when it produces an external swelling.

When the effused blood has become decomposed, its presence in the general cavity of the peritonæum must inevitably produce severe peritonitis. If, then, the symptoms laid down as indicative of this change in the coagula are present, while those of diffuse inflammation are wanting, there can be no doubt that the effusion has become perfectly encysted, and it may then be treated as a common abscess.

Now, the propriety of opening a common abscess in the neighbourhood of, or among the viscera, depends mainly upon its exact position. When the blood is collected at the lower part of the abdomen, it invariably lies in contact with the parietes of that cavity, and consequently there can be no danger of consecutive effusion from the operation of puncturing the sac, while we are never perfectly sure that ulceration, or some accidental injury, may not rupture the latter, and thus produce this dreaded complication. If, then, the symptons are marked and urgent, the puncture should not be delayed until a disposition is displayed to point externally: the pleximeter is in such cases a guide for the surgeon.

The case is very different when the accumulation takes place above the lower edge of the omentum, for there is then no certainty as to the adhesion between the cyst and the abdominal parietes; one or more folds of the omentum may intervene, and the operator may be obliged to traverse the cavity of the peritonæum before he can arrive at that of the effusion. We confess that our dependence in the powers of nature is stronger, under such circumstances, than in those of art, even in the most desperate cases.

It only remains to consider the mode of performing the operation. Most surgeons have resorted to a small puncture, sometimes in consequence of their dread of the admission of atmospheric air into the sac, an accident no longer considered very serious, in England or America; sometimes from a fear of the contents of the cavity becoming degenerated by the atmospheric influence. Both these dangers were much insisted on by Pelletan. With regard to the latter, however, which seems somewhat better founded than the former, it should not be forgotten that in every case requiring the operation, the blood is already degenerated, and that if the case terminates favourably without surgical aid, the very influence which causes our alarm is called into play by the natural ulceration and bursting of the parietes of the sac; so that by objecting to free puncture, we subject ourselves to all the dangers of delay without securing any ultimate advantage. Larrey practised an oblique puncture somewhat on the principle of the valvular opening of Abernethy, employed in psoas abscess; but Velpeau (*Op. Cit.*) recommends a free opening, without exerting any pressure to assist in the evacuation of the fluid contents or coagula, leaving this entirely to nature and the contractility of the cyst. This he considers the surest method of preventing the ingress of air, which he still regards as a matter of some importance. We conclude with a remark upon one other recommendation of the same author. "In short, we may, and, indeed, ought to, particularly when there is reason to fear that the adhesions have not yet acquired all the firmness or extent desirable, open these effusions in the manner recommended by Dr. Graves for opening all sacs situated in the abdomen; that is, we should divide the parietes of the abdomen, layer by layer, until we reach the cyst, which we should not immediately enter, but, keeping the wound unclosed, we should wait until the morbid sac becomes adherent and opens of its own accord." The case here particularly discussed is precisely that in which it is most dangerous for the surgeon to interfere at all. We can see no propriety in employing the knife until the completion of the adhesions has been placed beyond a doubt.

Reynell Coates.

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2d. *Effusions of bile into the peritonæal cavity* may result from any of the causes which produce contusions or wounds of the abdomen. The accident is not ex-

tremely rare, and cases are narrated in almost all the general works on pathological anatomy and surgery. It resulted from the attempt to puncture supposed abscesses, in three different individuals, under the observation of PETIT. (*Mém. de l'Acad. R. de Chir.* Tom. I. p. 281.)

Ulceration from internal causes may also open the gall bladder, or some of its ducts, as has been noticed by various writers. STOLL, PORTAL, LESEURE and DESJARDINS, (*Rec. de la Faculté de Méd.* Tom. XXII.) and MARTIN-SOLON, (*Bullet. de la Faculté*, 1821.) relate cases of the former, and SCOUTETTEN and ANDRAL, of the latter.

The effusion of bile from external causes is considered almost necessarily fatal: only two cases of recovery, are on record, so far as we have been able to discover, viz. the one detailed by PAROISSE, (*Opuscules de Chir.* p. 255.) and that published by Mr. FRYER of Stamford, (*Med. Ch. Trans.* V. 5.). This last is discredited by VELPEAU, who thinks the surgeon was deceived in the nature of the fluid, supposed to be bile, forty-one pints of which were drawn off at four different times during thirty-five days, by puncturing the abdomen.

In traumatic effusion of bile, the fluid is very rapidly diffused, and extreme irritation is the result; severe pain is felt at the moment of the accident, the abdomen swells rapidly, respiration is difficult, and the urine is suppressed, or flows in very small quantities. The peritonitis is not always general, but the pain is excruciating, and the depression of the system great. There is perhaps less vomiting and nausea than in many other injuries of the viscera. The deep jaundice which marks hepatic derangement comes on very soon; but in the absence of an external wound it is not possible to determine, with certainty, the nature of the accident. Death follows, sometimes in a few hours, sometimes in three or four days, or at a later period. The bile does not commonly penetrate between the convolutions of the intestines. REYNELL COATES.

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3d. *Effusions of Urine.* Wounds or other injuries of the kidney or ureter very rarely occasion the effusion of urine into the cavity of the peritonæum; their situation behind that membrane almost always determines the discharge toward the cellular tissue of the loins. It is therefore from ruptures and wounds of the bladder that this dangerous effusion commonly results. The causes of such accidents are very various: wounds, contusions, carelessness in performing the operation for calculus, or in the introduction of sounds, strictures in the urethra, enlargement of the prostate gland, paralysis of the bladder, et cætera, have each occasionally produced communications between the bladder and the cavity of the abdomen, and consequent urinary effusion.

The pain occasioned by this accident, though it soon becomes extremely severe, is not generally felt, upon the instant. The patient may remain for a time unconscious of the nature of the injury, as happened in the cases mentioned by CUSACK. (*Dubl. Hosp. Rep.* V. 2.) Excessive pain in the hypogastric region, and the usual symptoms of great peritonæal irritation, soon make their appearance. The patient either does not urinate at all, or discharges but a little bloody urine. The introduction of the catheter has generally no better result. Violent peritonitis is established in a short time, and death ordinarily follows between the third and twelfth days. In the dead body, a great quantity of urine, for the most part clear and untroubled, is found in the cavity of the abdomen, where it is widely diffused like the serum in ascites, unless when checked by adhesions among the viscera. A case is narrated by M. HOURMANN, (*Clin. des Hôp.* Tom. I. No. 14.) in which neither thickness nor reddening of the peritonæum was discovered.

It is quite possible that very small effusions of urine may become encysted and the patient may recover, but in the existing state of our pathological knowledge, the presence of urine in the peritonæum is considered fatal. When, however, the effusion takes place into the external cellular tissue, as, in wounds of the bladder, it very often does—the result, under proper treatment, is generally favourable. (LARREY, *Mém. de la Chir. Milit.*)

The treatment of wounds of the bladder has been given in a preceding section. When effusion into the abdomen has actually taken place, there can be no doubt of the propriety of puncturing the abdomen and giving it vent. Abundant use should be made of mucilaginous drinks,

and it has been recommended to dilute the effused urine and wash the peritonæum by injecting warm water through the puncture. In circumstances so desperate, no objection can be urged with reason against this apparently dangerous practice.

4th. *Effusions of the contents of the alimentary canal.* As all parts of the intestinal canal are liable to be opened, either by external or internal causes, it follows that effusion of any of its very various contents may take place. We have already spoken of the mode by which nature opposes effusion into the abdomen, when treating of internal hemorrhage. The same remarks apply with equal force to cases of wound or rupture of the stomach or other parts of the canal; but here there is an additional obstacle in the way of general effusion. In all viscera lined with a mucous coat, this membrane is redundant, and as the fibrous and peritonæal coats retract when divided, there is always, as Mr. TRAVERS discovered, a hernia or protrusion of the lax edges of the mucous membrane. When there exists an external wound, this protrusion, which of course corresponds with it, greatly facilitates the egress of the intestinal contents; but when no such wound occurs, the edges of the mucous membrane are applied upon the peritonæum lining of the abdominal parietes or covering the neighbouring viscera, with which, however, they show no disposition to unite. Now, when the canal is perfectly at rest, there is no tendency in the contents to escape, because of the perfect equality of hydrostatic pressure which reigns throughout the abdomen; but when the canal is distended so as to call into play its tonic action, or when the peristaltic motion urges the contents toward the opening, as was observed by TRAVERS in his experiments on dogs, (*On Injuries of the Intestines,*) their exit is opposed by these free edges, which act in the manner of a valve: the greater the pressure, the greater the difficulty of egress, until the neighbouring surface is depressed sufficiently to allow of the complete eversion of the protruding mucous membrane. (See *Intestine.*)

Notwithstanding these barriers, which fully explain the non-existence of effusions after many penetrating wounds of great extent, such effusions frequently occur and are always to be dreaded.

The urgency and severity of the symptoms depend mainly upon the part of the canal from which the effusion takes place. First in danger are perhaps those from the duodenum, in consequence of the bile which is discharged into that viscus; next, those from the great intestine, containing matters totally excrementitious, and unfitted for entering the system by any route; then, those from the stomach, crude, almost or altogether foreign in their nature, and often highly stimulating; and lastly, those from the small intestines, which by their admixture with chyme are rendered somewhat less irritating. The effusion of chyle, though spoken of by most of the older writers on pathological anatomy, can never be very considerable in amount, when pure; and if detected at all, in cases of death from peritonitis, it could hardly be regarded as the cause of so much mischief: like small deposits of blood, its presence would scarcely be resented. As VELPEAU very justly remarks, if the thoracic duct should be burst by distension, the effusion would take place in the cellular tissue, not in the peritonæal cavity.

When effusion occurs, there are three modes in which the case may terminate: First: in consequence of pre-existing adhesions, or the formation of a new cyst, the rejected contents of the intestine may be cut off from all communication with the peritonæum, and the route of the fecal matter being continued, in part at least, from the commencement, the effused substance and the pus occasioned by its presence may be returned eventually into the natural canal, of which a portion of the sac continues ever after to form a part. (See *Intestine.*) Secondly: The cyst may form an abscess and tend gradually toward the surface, as LE DRAN, M. BLANDIN, VELPEAU, and others, have observed. It should then be opened as soon as possible. (See *Abscess.*) Lastly: the effusion may become general, either primarily, or by the rupture of a cyst; all the horrors of a fatal peritonitis then follow with rapidity: the last is unfortunately the most frequent termination. (See *Abdomen*, *Wounds of*, and *Peritonitis.*)

5th. *Effusions of Pus.* Though the proper sero-purulent secretion of the inflamed peritonæum differs considerably from true pus, the latter is sometimes found effused into the abdomen in consequence of wounds or abscesses of the liver, spleen, or other solid organs contained within it; and the same thing happens, though very rarely, from abscess in the parietes pointing internally, as has been remarked by FABRICIUS HILDANUS, and LIEUTAUD. When this effusion becomes encysted, it differs in no respect from an internal abscess. (*q. v.*) When diffused, it produces effects similar to blood, differ-

ing only in the greater difficulty with which it is absorbed, and in the more frequent consequence and greater severity of peritonitis.

For farther information on particular effusions, see the articles on the several organs interested.

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§ 5. Abnormal Adhesions of the Abdominal Viscera.—The serous membrane which covers the abdominal viscera and lines the cavity in which they are contained, has a strong tendency to adhesive inflammation, and when this morbid action is excited, an agglutination together, to a greater or less extent, of the contained and containing parts, is the consequence. These adhesions are sometimes salutary, at others they are productive of more or less inconvenience and even of fatal results. When the viscera are punctured or ruptured, the adhesive inflammation of the peritonæum which immediately supervenes, by agglutinating together the parts in the vicinity of the injury, often permanently prevents the effusion of the contents of the organs; and even when extravasation takes place, it beneficially confines the effused matters in one mass by rapidly inducing the adhesion of the surrounding parts, and thus effectually limiting the extent of the effusion, and preventing the irritation of the extravasated matters from extending to the remainder of the abdomen. When inflammation is excited in any of the abdominal viscera, and matter forms, the adhesion of the inflamed viscus to the abdominal parietes prevents the extravasation of the matter into the peritonæal cavity. Extraneous substances in the alimentary canal, which cannot be transmitted along it, frequently produce adhesion of that portion of the tube in which they are arrested, to the abdominal parietes, where a tumour forms, by opening which the foreign body may be discharged. In suppurating tumours of the abdomen, which gradually increase and open externally or into the hollow viscera, as abscesses of the liver, &c., these adhesions prevent the effusion of foreign matters into the peritonæal cavity; they also sometimes limit the purulent collections, effusions, or other foreign substances in the abdomen, by surrounding them with false membranes.

Very frequently, these adhesions become of themselves a source of inconvenience, and may even be productive of fatal consequences. Thus, after recovery from peritonitis, patients frequently suffer, at intervals, from colicky pains, vomiting, or other disorders of the digestive organs apparently resulting from the adhesions between the abdominal organs which impede their movements; and sometimes the patient is bent forwards, and experiences pain on attempting to straighten his body, in consequence, it has been supposed, not without plausibility, of adhesion having taken place between the omentum and the lower part of the abdomen. These effects are observed to the greatest extent in chronic peritonitis, by which all the abdominal viscera are united into one mass; and after the termination of the disease the patient is affected with obstinate and repeated vomiting, arising, in great part, from the immobility and coarctation of the intestines. Fatal internal strangulation of the viscera sometimes results from these adhesions, an accidental ring being formed by them, into which a fold of intestine is forced. Sterility is also the necessary consequence of all adhesions of the fallopian tubes or of the ovaries, which prevent the proper application of the former to the latter; and according to M. Dance (*Dict. de Méd.* I. 204.) and Mad. Boivin, (*Recherches sur une des causes, &c., de l'avortement,*) such adhesions between the uterus and its appendages, and the surrounding parts, are a frequent cause of abortion, by preventing the ascent of the uterus, and, consequently, the completion of gestation. These adhesions also in ascites sometimes separate the fluid in distinct sacs, and prevent fluctuation from being perceptible; in this case, if a portion of intestine is agglutinated to the abdominal parietes at the place where paracentesis is usually performed, and this is not ascertained by percussion, the gut may be punctured by the trochar.

These adhesions do not, however, in general, occasion any great inconvenience unless they are intimate and affect the moveable viscera; and even then the inconvenience may not be permanent, as the bands of coagulable lymph which form the adhesions, often, after a time, become elongated so as to allow the necessary freedom of motion to the viscera.

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§ 6. Fistulæ of the Abdomen.—There is no part of the body in which fistulæ occur more frequently than in the abdomen. They are produced by ulcerations of the stomach, of different portions of the intestines, of the gall bladder, kidneys, ureter, and even urinary bladder, which are preceded by adhesions of these

organs to the abdominal parietes, and open externally; these openings sometimes remaining permanent. They are also a frequent result of strangulated hernia, and of all injuries and operations which impair the continuity of the hollow viscera. Sometimes they are produced by foreign bodies, portions of an encysted fœtus, &c., in the abdominal cavity; by deep-seated caries, or remote collections of pus. Simple fistulous ulcers are occasionally produced within the abdominal parietes, by a separation of the aponeurotic sheaths, or by the destruction of the cellular tissue which surrounds them. Some fistulæ of the abdomen are congenital, as the extrophy of the urinary bladder above the pubis, certain cases of artificial anus, &c. Fistulæ of the abdomen do not always open externally, but form an abnormal communication between the organs, as, for instance, between the ovary, uterus, vagina, or intestine, and the urinary bladder or ureter; between the kidney, ureter, or gall bladder, and the colon; between two folds of intestine, &c.

These fistulæ not demanding any particular treatment, on account of their seat, it is unnecessary to anticipate here what must be said in the general Art. *Fistulæ*, and under the head of the organs implicated in this disease. I. H.

§ 7. Foreign Bodies in the Abdominal Cavity.—Extraneous substances of various kinds occasionally find their way into the peritonæal sac; and this takes place, for the most part, through apertures in the hollow organs of the abdomen, formed by ulceration. It is in this way that urinary and biliary calculi, balls of hair and other substances, worms, &c., reach that cavity. These bodies speedily excite adhesive inflammation in their vicinity, and they become entirely surrounded by an inclosure of coagulable lymph, and thus are rendered harmless; or suppuration takes place, and the abscess, with its cause, is discharged externally, or into one of the hollow organs. By this latter process foreign bodies are transferred from one of the viscera to another; as from the ureter to the colon, or from the intestines to the bladder, &c. The belief that worms gain the peritonæal cavity by penetrating the coats of the viscera, is now generally abandoned, and it appears well determined that they reach that cavity by simply traversing the apertures formed by ulceration induced by other agents. In abdominal pregnancies, the fœtus is developed in the peritonæal sac, and it often is deposited there in cases of extra-uterine fœtation, whether of the fallopian tube or intestinal canal, or from rupture of the uterus. The principles upon which these cases are to be treated have been already detailed in the articles on ruptures and complicated contusions of the abdomen, and it is unnecessary here to add anything farther on the subject. I. H.

§ 8. Loose Bodies in the Abdominal Cavity.—A few cases are on record, in which bodies have been found lying loose in the peritonæal sac, and without apparent lesion of any organ. Planque states that he discovered in the abdomen of a person who had died from some other cause, a smooth cartilaginous-like, ovular body, fourteen lines long, ten broad, and containing at its centre a smooth round stone, like a pea. This body was entirely free from adhesions. M. Lebidois met with two of these bodies in the same subject. They were of the size of a large nut, white, smooth, shining, hard, compact, elastic, of an ovoid figure, and resembling the head of the femur when recently removed from the acetabulum. One of these was found in a cyst below the spleen, and the other floating in a cellulo-vascular cyst between the rectum and bladder. (*Archives Générales.* IV. 579.) M. Velpeau (*Dict. de Méd.*) met with one of these bodies in a young woman who had died of phthisis pulmonalis. There was no lesion of any of the abdominal viscera. The body was found in the peritonæal sac, between the cœcum and vertebral column, and free from any attachment. It was of the size and form of a chestnut, of a yellowish colour, shining, moist, elastic, very dense, harder externally than internally, presenting no appearance of fibres, and could be broken with the fingers. We do not as yet possess a sufficient number of cases to form any satisfactory etiology of these bodies, or to determine whether they are formed in the same manner as urinary concretions, as M. Bouillaud appears to think; or are the remains of pediculated tumours, which had formed exterior to the peritonæum, and had fallen into that sac, as Beclard supposes, who compares them to the loose cartilages of the joints; or, finally, whether they are the remains of sanguineous effusions, thus altered, as M. Velpeau inclines to believe. There appears, however, to be no ground to suppose that they originated in the digestive canal or urinary bladder. I. H.

§ 9. Abdominal Tumours of Various Kinds, foreign to the Viscera of that Cavity.—These are developed in the cellular tissue exterior to the abdominal or-

gans, or on their free surface, and form solid masses or encysted tumours of various sizes. M. Lebidois relates (*Archives Gén.* VI. 67.) a case in which there was a scirrhus mass weighing nine pounds, united to the uterus which was in a cancerous state; twenty tumours, also scirrhus, were found within the layers of the omentum; several in the mesentery; others adhering to the small intestines; six or eight attached to the concave surface of the diaphragm; and a large number were contained in the thoracic cavity. In a case of cancer of the pylorus and liver, M. Chomel found the peritonæum covered with a multitude of small spheroidal tumours united to this membrane by a slender pedicle, presenting, on pressure, a cerebriform appearance. (*Bull. de la Fac.* 1815. No. 1.) Similar cases are related by Andral, (*Chirurg. Med.* IV. 650.) Velpeau, (*Revue Méd.* II. 177.) M. Dance states that he has seen a cancerous mass as large as a man's head very speedily developed in the cellular tissue lining the iliac and lumbar fossæ. (*Dict. de Méd.* I. 208.)

Other tumours of various kinds are sometimes developed on the exterior of the abdominal viscera and simulate enlargements of the liver, spleen, uterus, or even a hernia, according to their situation. The diagnosis of these tumours is very difficult, and as they are readily mistaken for some one of the organs in their vicinity, it is at least highly important that the possibility of the existence of such tumours should be known. I. H.

§ 10. Fatty Tumours of the Abdomen.—All parts of the abdomen are occasionally subject to tumours formed by the excessive growth of the adipose tissue. Even the cavity of the peritonæum, like that of any other serous membrane, is not entirely exempted from such depositions; Mr. Abernethy mentions a case of this nature in his *Surgical Observations.* When such tumours are situated upon the exterior surface of the muscles or tendinous fasciæ of the abdomen, they require no especial notice here (see *Tumour*); but when they are located in the vicinity of the abdominal ring, in the substance of the spermatic cord, or in the cellular tissue immediately in front of the peritonæum, they frequently give rise to a suspicion of epiplocele; and in some instances, surgeons of great experience have been completely deceived by them.

The first notice of these spurious herniæ is found in Heister, (*Institut. Chir.* Pars. 2. s. 5. 121.) He speaks of the spermatic cord becoming so extensively enlarged by the deposition of fatty matter among its vessels, that it might be mistaken for a hernia. The usual seat of these tumours is in the parts about the internal abdominal ring and the neighbourhood of the linea alba from near the umbilicus to the ensiform cartilage: they always take their rise in the cellular tissue attached to the outer surface of the peritonæum, and frequently in the duplicature of the falciform ligament of the liver, gradually insinuating themselves through the areola of the tendons, to expand beneath the integuments.

Morgagni was the first to fix the attention of surgeons upon these singular productions, now known by the title of fatty herniæ. He notices the case of a prince, who carried one of them a little above and to the left of the umbilicus, (*Epist.* 43. *Obs.* 10.) and states, that in an elderly woman whom he dissected, he found another near the ensiform cartilage. (*Epist.* 50. *Art.* 24.) He refers to Schulz, (*Act. Nat. Cur.* Tom. I. Obs. 225.) and to Petschius, (*Syllog. Anat.* § 89.) for two cases in which the tumours occupied the inguinal canal. Several examples are given by Pelletan, (*Clin. Chir.* Tom. III. p. 33, &c.) in one of which, both canals were occupied, the tumours descending to the scrotum; a second, presented one on the left side only; and in a third case, there was one in the right inguinal canal, one under the left crural arch, two above the umbilicus, and three others at a considerable distance from the median line. Pelletan afterwards met with numerous instances of the same nature. Fardeau relates one in which there were three such tumours upon a single patient. (*Recueil Périod. de la Soc. de Méd. de Paris.* Tom. XVIII. 268.) Deschamps (ib.) notices another. Several are given by Scarpa, (*Traité des Hernies, trad. par Cayol et Ollivier*, p. 337.) Mr. Lawrence frequently encountered them in his dissections. (*Treatise on Ruptures.*) Ollivier (*Translator's Note to Scarpa,*) gives one case. Others are narrated by M. Bigot, (*Thèses*, Paris, 1821.) from the Clinique of Richerand; Cruveilhier, (*Anat. Path.* Tom. II. p. 268.) from that of Dupuytren; Velpeau, (*Dict. de Méd.*) from the wards of La Pitié, &c.

When seated at or near the linea alba, these fatty herniæ seldom attain any very considerable dimensions, generally varying from the size of a nutmeg to that of an egg. Their structure, in this situation, is extremely simple; a few granules of adi-

pose matter exterior to the peritonæum become gradually engaged in one of the little openings or areolæ formed by the fibres of the tendinous aponeurosis, and, by continual growth and expansion, are converted into a pediculated tumour, of which the root is attached to the peritonæum, the neck embraced by the fibres of the aponeurosis, and the head expanded beneath the integuments. They are generally more firm when small, and when they traverse a narrow aperture, than when they are larger and more free from restraint. They are often capable of reduction, but sometimes remain permanent. The continual dragging to which they are subjected, not unfrequently occasions a funnel-shaped elevation of the peritonæum from which they arise, and thus they present a cul-de-sac, surrounded by a fatty tumour, into which Velpeau supposes that true herniæ may gain admittance: Pelletan thinks that this danger does not exist, as there is always a sufficient collection of fat about the root of the tumour to prevent the approach of the intestines or the omentum. These tumours sometimes inclose serous cavities which form complete cysts, independent of the peritonæum.

Fatty herniæ generally occasion no pain, or inconvenience, and often attract no attention during life; but when they are prolonged deeply into the duplicature of the falciform ligament of the liver, as was the case in a number of the instances quoted above, it is not improbable that, as M. Ollivier supposes, they may occasion great uneasiness from the consequent dragging of the liver and peritonæum by the motion of the abdominal muscles. Velpeau thinks that the severe symptoms sometimes observed in persons affected with these tumours, may result from constriction of the neck, but Scarpa regards them as originating accidentally from causes altogether disconnected with the disease in question.

These tumours cannot be distinguished with certainty from epiplocele; for although Scarpa declares that they are generally firmer and less compressible, yet when the omental hernia has subsisted for a long time, when it has contracted extensive adhesions to the surrounding parts, or become indurated by inflammation, this test loses its value.

Pelletan was the first to explain the mechanism of fatty hernia when it makes its exit through the inguinal canal. He dissected three cases of this character, and in all, he found that the mass of adipose matter descended in precisely the order observed by the testicle in reaching the scrotum; that is, the tumour first depressed the peritonæum until it acquired certain dimensions, when it adhered to that membrane so as to provide itself with an additional coat; after this, it was gradually drawn toward the abdominal ring, carrying the process of the peritonæum with it, until it found itself opposed in its descent by the portion of that membrane which closes the ring around the spermatic cord. This portion was gradually dilated by the continual action of the tumour, until the latter became invaginated, and descended into the scrotum.

Thus the mass of adipose matter in the scrotum is situated precisely like the testicle in the tunica vaginalis, being invested by two processes of the peritonæum, one adherent and the other free, while the tumour remains as it was originally formed—external to both. The same thing occurs sometimes when the fatty hernia passes out through other natural canals, but its arrangement is nowhere else so uniform.

Pelletan saw the adipose matter entirely free from a peritonæal covering, in the instance cited, in which it appeared beneath the crural arch; and at the umbilicus it is generally uncovered in like manner. In the scrotal cases the reduction appears to be effected with great ease, and the sac itself sometimes returns with the tumour. Although the serous cavity formed by the double extension of the peritonæum, remains unadherent, and communicates freely with the abdominal cavity, like the tunica vaginalis in congenital hernia, the new matter occupies the sac so completely that the viscera rarely descend, so as to render the case complicate.

The diagnosis of fatty tumours of the abdomen is extremely difficult. Their gradual growth, and the absence of pain, on pressure, even when sufficiently firm to produce suffering in other parts of the abdomen, are the most characteristic symptoms; but almost every surgeon who describes them has been occasionally deceived by their close resemblance to epiplocele. Fortunately this is not a matter of serious moment, except when other accidents produce the ordinary symptoms of hernia, when the surgeon, attributing them to the presence of the adipose tumour, proceeds to perform an operation which at length exposes the deception. The cases mentioned by Cruveilhier, Ollivier, and Scarpa, are of this description—and Velpeau was saved from the same error by the death of his patient

before the hour for operating had arrived: post-mortem examination discovered a peritonitis originating from disease of the fallopian tubes.

We give an abstract of SCARPA's case, as being one of the most remarkable and instructive. The patient was a woman of fifty-five years of age, somewhat embonpoint, of soft fibre, and had been long subject to hysteric symptoms. She had been taken, on the preceding night, with severe intestinal colic, which she attributed to strangulated hernia. A little below the umbilicus, and to the left of the linea alba, there was a tumour, of the size of a large walnut, without change of colour in the skin. The abdomen was tender, the extremities cold, the pulse small and concentrated. There was nausea and a desire to vomit, and the alvine discharges were checked. Though subject to pain in the bowels, she had never suffered so much before. She had eaten imprudently of crude vegetables, and she conceited that the tumour had become enlarged and painful. Convinced that this was a strangulated epiplocele, SCARPA proceeded immediately to the operation. There was no trace of a sac; the tumour was a simple mass of hardened fat, with a pedicle traversing the linea alba; it was removed with one cut of the scissors; and by means of warm baths, castor oil, in small doses, often repeated, emollient clysters, and other remedies, the patient soon recovered. The disease was colic.

When no unpleasant symptoms are present, these tumours demand no attention; but when disorders simulating those of strangulated hernia occur, there is, perhaps, but little reason to regret the performance of the operation, even under a false impression, except when the affection is seated at the abdominal ring or crural arch; for the nature of the case is instantly discovered, the operation is very slight, the removal of an inconvenience and a fruitful cause of alarm is effected, the danger of true hernia is diminished, and the nature of the more pressing malady is elucidated. But when the inguinal canal is traversed by the mass, the operation becomes serious, both in its immediate and ultimate consequences, and it is important to avoid it if possible. A truss is of course proper in cases of this character, as in true inguinal hernia.

REYNELL COATES.

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WALTHER. *Über die angebornen Fetthautgeschwülste und andere Bildungsfehler.* Landshut, 1814.

MECKEL. *Handbuch der Path. Anat.* Leipzig, 1812. Bd. 11.

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I. H.

§ 11. ENCYSTED DROPSY OF THE ABDOMINAL PARIETES.—The name of *Hydrops peritonæi* was given by TULPIUS to a species of encysted dropsy located between the peritonæum and the abdominal muscles or their aponeuroses. This peculiar disease was first distinctly described by JOHANNES ACHOLZINO. (See *Sepulcretum.* Sect. 21. Obs. 21. § 16.) MORGAGNI, who dwells upon this subject at great length, refers to a host of examples in the writers of his own and the preceding age; but few of them, however, are satisfactory, in consequence of the imperfect statement of the appearances after death. He never met with a case in the course of his own practice, and it is still regarded as extremely rare. Of the cases mentioned by this celebrated commentator, (*Epist.* 38. Art. 46, et seq.) some were evidently produced by clustered hydatids, some were probably connected with the fallopian tubes or the ovaries, and, of the remainder, many are not clearly of a dropsical character. But there are still a sufficient number of well authenticated examples on record to prove the existence of this disease, and to render future investigation on the subject highly desirable.

A large majority of the cases occur in women, about the period of the cessation of the menses, particularly in those of loose fibre who have been subjected to great distension of the abdomen in gestation; but it has also affected younger married women, and even virgins. But one instance of the kind is noticed as occurring in a man; it is related by ANHORNIUS. (*Ephem. Nat. Cur. Cent.* 9. Obs. 100. n. 2.)

The *causes* of encysted dropsy of the abdominal parietes are not well understood. By MORGAGNI it is attributed to the pressure produced by the uterus in gestation, by violent cough or great exertion, or to the action of stays or corsets; although in many cases it appears spontaneously. Not unfrequently, the patient dates the first symptoms from a blow upon the part. It commences with a small circumscribed hard tumour, seated beneath the muscles or their aponeuroses, which is sometimes movable under the fingers, in a slight degree. It is not accompanied by any change in the appearance of the in-

teguments, and is at first but slightly painful. It soon begins to increase, its growth being sometimes rapid, but more generally very slow. It remains distinctly circumscribed for some time, giving rise to a dragging sensation, and to difficulty of respiration, proportioned to the embarrassment of the viscera and the movement of the diaphragm from its bulk and pressure. The patient also complains of lancinating pains in the tumour. As the cyst increases in size, it becomes spread over the whole front of the abdomen, loses its softness, and simulates a genuine ascites. Occasionally it transcends the limits of the abdomen, and involves the groins, and even the front of the thighs. This enlargement sometimes requires years for its development; but it takes place, occasionally, in a much shorter time.

The cyst is formed internally of the peritonæum, which sometimes contracts adhesions with the viscera, in consequence of the pressure; externally, it is formed of the cellular substance beneath the muscles and tendons, which it elevates and finally involves so that their structure becomes more or less completely changed. The cyst is very thick and firm, and occasionally presents small serous cavities within its substance. It does not collapse when opened. Sometimes, instead of one, there are several cysts, which finally coalesce; the veins around the tumour become enormously enlarged and varicose, as in sarcoma; and the contents of the sac vary from a clear serum, or a gelatinous and tremulous mass, to a bloody sanies, or puruloid fluid.

The *diagnosis* is obscure. When small, the tumour may be confounded with cold abscess, from which it differs, in showing no disposition to point; and when large, it may be mistaken for ascites. It is distinguished from this latter disease by the fluctuation being much less distinct; by the tumour preserving nearly the same relative situation in all positions of the body; by the absence of a sense of internal weight about the pubis when the patient stands erect; by the countenance generally remaining unaltered, or at least presenting a different expression from that observed in ascites; and from the absence of all visceral derangement other than that which results from the great weight and pressure of the cyst. The mental powers continue unimpaired, and there is no consequent derangement of the catamenia when it occurs in young women.

The *prognosis* in this disease is most unfavourable. The sac continues to enlarge, and if not evacuated by the surgeon, it eventually bursts, either into the cavity of the peritonæum, as has been observed by Chomel, (*Mém. de l'Acad. Roy. des Sciences*, an. 1728.) Mediavia, (*Morg. de Caus. et Sed.* Ep. 38. Art. 51.) Tavernier, as reported by Le Dran, (Obs. 65.) and several others; or externally, as in the remarkable case described by Degner, (*Acta Cur.* V. 5. Obs. 2.) and in that of La Motte, quoted by Boyer. Sometimes the sac opens into the intestines, and gives rise to a discharge of fecal matter externally; as occurred, after a puncture had been made for the evacuation of the cyst, in the case narrated by Chantourelle. (*Archives Générales de Méd.* XXVII. 218.) When the sac opens internally, the case is necessarily fatal; but when the rupture takes place in the integuments, the parietes become gangrenous, and may be thrown off as an eschar; there is then some chance of recovery. In the case related by Degner, the tumour covered not only the whole front of the abdomen, but a considerable portion of the thighs; yet the cyst was separated entire, and the patient recovered. The result in La Motte's case was equally favourable.

When the tumour has enlarged to a great extent, the *treatment* should be merely palliative; it is even questionable whether the puncture of the sac should then be attempted, as it has in some cases accelerated the fatal termination. A valvular opening, and graduated pressure by bandage and compresses, are evidently indicated; for the thickness of the walls of the cyst is such that they cannot collapse upon the evacuation of their contents. The terrible effects of keeping open the orifice to permit of a constant draining of the cavity, are strongly portrayed in M. Chantourelle's case, already mentioned; the cyst inflames and speedily mortifies, the peritonæum and integuments are alike involved, the intestines become gangrenous, and the patient dies in a horrible condition.

When the tumour is small, the application of leeches, and other local antiphlogistics, together with strict abstinence when the state of the patient warrants it, may check or diminish its growth. There can be no question of the propriety of extirpating the tumour by the scalpel, if the surgeon can be assured that it does not involve the peritonæum, properly so called. The cases mentioned by Degner and Le Dran render it probable that the cyst is sometimes independent of the peritonæ-

um; for it is not to be believed that a large portion of the latter membrane could slough away, under any circumstances, without destroying the life of the patient. The cavity should be punctured early, when the contents appear fluid. It has been proposed by some, (DANCE, *Dict. de Méd.* I. 215.) that the exfoliation of the sac at this early period, should be produced by incision or caustic; but until the precise seat of the disease is more completely ascertained by future pathological anatomists, such a course cannot be adopted without great risk. Indeed, whenever the caustic could determine the separation of a cyst on the front of the abdomen, without involving the cavity, the same thing might be effected with the knife, with infinitely less danger of peritonæal inflammation, than must necessarily result from the proximity of a large suppurating or gangrenous surface.

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I. H.

§ 12. PHLEGMONS AND ABSCESSES OF THE ABDOMEN.—1st. *Abscess of the abdominal parietes.* These abscesses form, 1st. between the peritonæum and the abdominal muscles; 2d. between the layers of these muscles; and 3d. immediately beneath the skin. The last do not differ in their characters from abscesses in other parts of the body, and therefore will not require any special consideration, (see *Abscess*); the others, however, present some peculiarities worthy of notice. Their formation is usually attended with very acute pain and considerable fever, in consequence of the great number of nerves distributed to the abdominal parietes, and the resistance which the muscular or aponeurotic layers separating the phlegmonous tumour from the skin, present to its development. Thus these tumours are at first diffused and but slightly elevated, hard and extremely sensible to the touch, and they but slowly come to a head, some time being required for the matter to reach the skin; sometimes they appear to project more within the abdomen than externally, and to impede, by their size and weight, the action of the subjacent viscera. Moreover, after the evacuation of the purulent matter, there almost always remains around the purulent cavity, some hardness which but slowly disappears. The pain is aggravated particularly by every effort which requires the action of the abdominal muscles; as coughing, deep inspirations, the straightening of the body, and the discharge of feces or urine. The most frequent termination of these engorgements is by suppuration, and although they often form nearer to the peritonæum than to the exterior surface of the abdomen, they rarely discharge into the former cavity. An instance of this, has, however, been reported by LE DRAN. The rarity of this latter termination has been ascribed to the thickening of the peritonæum in the vicinity of the abscess; but M. DANCE thinks that it is probably for the most part owing to the natural resistance of the viscera of the abdomen, joined to their peculiar expansive movement; thus, he observes, we see that effusions in this cavity, resulting from a penetrating wound, have a tendency to collect around the wound and to escape by its opening. It appears to us, however, to be the result of a general law of the animal œconomy, by which all purulent collections have a greater tendency to discharge themselves upon the exterior surface of the body, than into an internal cavity.

The matter of these deep-seated abscesses of the abdominal parietes, presents one striking character, to which attention has recently been especially directed, and which is, that it frequently has an extremely fetid odour, sometimes similar to that of fecal matters, so as to lead to the belief of a perforation of the intestine, and its communication with the abscess. Cases in which this phenomenon has occurred have been reported by LE DRAN, BASSEREAU, (*Journ. Univ. et Hebdom.* Tom. VII.) &c. M. DANCE relates the four following, in the *Archives Générales*, for October, 1832. A female, 35 years of age, had experienced, for three weeks, a fixed pain in the centre of the space which separates the umbilicus from the crest of the ilium, on the left side. There was at that spot a tumefaction, which was hard, very sensible to the touch, moderately elevated but flattened, of the size of the palm of the hand, and the colour of the skin covering it was unchanged. By the tenth day this tumour had become prominent, and fluctuation was observed at its summit, after having been the seat of the most acute tensive pain, which had deprived the patient of sleep during four consecutive nights. An incision was made in the centre of this tumour, and a glass-full of greenish pus discharged, which was thick and very fetid, its odour analogous to that of asafœtida; the next day this odour had ceased, and

in a few days the abscess, which was still tumefied around its circumference, completely disappeared.

A man, 29 years of age, addicted to intemperance, which rendered him subject to disordered digestion, took a large dose of Leroy's purgative medicine, and was attacked, three days afterwards, with a fixed pain in the epigastric region, with redness of the tongue, very acute fever, and other symptoms of intense gastric irritation. On the fifth day a swelling appeared in the epigastrium, which was elevated and seemed as if bolstered up by a large and hard body situated behind the abdominal parietes. The slightest touch to this part occasioned pain; coughing or a deep inspiration increased this pain; drinks could not be taken except in small quantity, as, by distending the stomach, they seemed to press painfully upon the tumour from within outwardly; the fever continued. For several days, notwithstanding the repeated detraction of blood, this tumour increased in every direction, so as to extend over the hypochondriac regions and to descend to the umbilicus. On the tenth day fluctuation was perceptible at one spot. On the twelfth day the abscess was opened, and a quantity of turbid, unhealthy, and extremely fetid pus discharged, the odour of which was similar to that of fecal matters. This odour ceased after 24 hours, and in the course of a month the patient was entirely cured. The cure was retarded by the time required for the dissipation of the induration which surrounded the abscess.

In a third case, there was a deep-seated abscess of the abdominal parietes, situated a little above the right iliac region, which discharged, externally, not only a purulent matter having a fecal odour, but also gas having the same fetor; the patient nevertheless recovered in a short time.

M. Dance thinks that it is not probable that in any of these cases, the odour of the purulent matter arose from the communication of the intestine with the abscess, the latter having promptly cicatrized without becoming fistulous; and there being, moreover, no appearance of proper fecal matter. The correctness of this opinion has been entirely confirmed in a fourth case, that of a workman, 42 years of age, who, after excessive fatigue, having walked 20 leagues in one day, was attacked with psoas abscess, which proved fatal, and afforded an opportunity for an examination. In this case the abscess discharged matter not only of a very strong stercoraceous odour, but also of a fecal colour; a fetid gas escaped at the same time, and there was a gurgling, on pressing the parts, which seemed to announce a communication between the intestine and abscess; nevertheless, on a most minute examination, it was found that none such existed. The odour appears in these cases the more closely to resemble that of feces, the nearer the abscess is to the intestine; as, in the fourth case, in which the abscess was separated from the colon only by the parietes of this viscus, the fecal halitus was most manifest. M. Velpeau has observed also that the smell of the pus varies with the situation of the abscess in the abdominal parietes. Thus, in a case in which the purulent collection was formed in the right groin, the pus emitted a marked stercoraceous odour; in a second, in which the abscess was situated in the epigastric region, the smell of the pus was rather sourish, not unlike that of imperfectly digested food; and in a third case, in which the matter formed lower down than in the preceding, the odour of the pus was analogous to that of the contents of the lower portion of the small intestines; the fecal odour was at least not perfectly marked. (*Journ. Univ. et Hebdom.* VII. 140.)

The fact that abscesses may exhale a stercoraceous odour without there being any communication between them and the intestine, is important to be known, as this odour is sometimes so striking as to lead to the belief of the perforation of the intestine, and, of course, to an incorrect diagnosis and prognosis.

It remains to explain how these abscesses acquire their fecal odour. Dance and Velpeau ascribe it to the transudation of the intestinal gas through the parietes of the intestine; it is, we can entertain no doubt, the result of a real penetration of the sulphuretted hydrogen, one of the gases which has been shown by Dr. Mitchell (*Am. Journ. Med. Sc.* VII. 40.) to possess the highest penetrating power. It is in the same way that we are to explain the circumstance of suppurations in the vicinity of excretory canals frequently acquiring the odour of the contents of these last, without any direct communication existing, as in many cases of abscesses at the margin of the anus, remarkable for their fetor, and in which no perforation of the rectum can be discovered; and also the spermatic odour of abscesses in the vicinity of the testicles and vas deferens.

Diagnosis. Deep-seated abscesses of the abdominal parietes may be confounded, at their commencement, with inflamma-

tion of the subjacent viscera, and especially with peritonitis; the pain, even at the outset, is, however, fixed, superficial, circumscribed, and limited to one spot, as well as the succeeding tumefaction, and this tumour makes part of the abdominal parietes, as in encysted dropsy of these same parts; but in this latter, the progress of the disease is essentially chronic.

Treatment. The indication in these inflammatory tumours is to prevent suppuration, and this is to be accomplished by the ordinary antiphlogistic remedies. When fever is present, venesection is usually required. Numerous leeches must be applied to the tumour, followed by emollient cataplasms; warm baths are also useful; absolute rest is necessary, and an antiphlogistic diet should be enjoined. When, notwithstanding these measures, suppuration takes place, the matter must be early evacuated and by a large incision, in order to prevent the extension of the abscess and the separation of the abdominal muscles.

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2. *Abscess of the right iliac fossa.*—These abscesses, situated exclusively in the right iliac fossa, and which form in the cœcum and in the cellular tissue immediately posterior to this intestine, are said to have long attracted the attention of M. DUPUYTREN; but we believe that MM. HUSSON and DANCE were the first to describe them, in a memoir published in the *Repert. d'anat. et des phys.* for 1827. In the *Archiv. Gén.* for June and August, 1828, there is a very particular and highly interesting account of them, by M. MENIERE; they are also described by M. DUPUYTREN, in his *Leçons orales*, since published; and some important additional information has been furnished by Mr. FERRALL, in the *Edinburgh Med. and Surg. Journal*, for July, 1831. Prof. CHANNING has related, in the *Boston Med. and Surg. Journ.* for 27th January, 1829, a case which appears to have been of this character, and he notices another which was under the care of Prof. JACKSON, of Boston.

The formation of abscesses in the particular situation alluded to, has been attributed to the disposition of the intestinal canal at that place, as also to the diseases to which that portion of it, is subject. The intestines cease to be floating and movable, at this spot, and the alimentary matters there assuming an excrementitial character, are obliged to advance in the intestines contrary to gravity; the small, also empties there into the large intestine by a narrow orifice, calculated to impede or arrest the progress of these matters; and finally, we most frequently meet in this part of the intestinal tube with inflammations capable of transmitting the irritation of the parietes of this canal to the surrounding cellular tissue. This opinion appears the more probable, as the abscesses under consideration are commonly preceded by symptoms indicative of disorder of the alimentary tube.

The *predisposing causes* of these abscesses are various. Sex and age exercise an influence; the disease occurring much more frequently in males than in females, and at adult age rather than at any other period of life. Of sixteen cases in the Hôtel Dieu at Paris, fifteen occurred in males, and eleven were over thirty years of age. (MENIERE, *Archiv. Gén.* XVII. 213.)

Disorders of the digestive tube caused by the exercise of certain trades, are said by M. DUPUYTREN to have a great tendency to produce these abscesses. House-painters, colour-grinders, and copper-turners, who are incessantly exposed to the dust and emanations of certain metallic irritants, suffer from colics and diarrhœas, which, after a time, have induced the formation of the tumour. Sedentary persons have been affected in the same way, after much

distürbance of the digestive functions. The place of residence also appears to exert an influence. M. Dupuytren states that he has seen several patients newly arrived at Paris, who evidently owed their complaint to residence in the metropolis.

The most common *causes*, however, of this disease, are the abuse of purgatives and of spirituous liquors, and indulgence in food of an acrid and indigestible quality. Every cause, indeed, which tends to produce irritation of the mucous membrane of the digestive tube, equally tends to develop phlegmon in the iliac fossa. The inflammation of the mucous membrane is in some instances, according to Mr. Ferrall, (p. 3.) propagated to the contiguous tissues, while in others abscesses result from the perforation of the intestine by ulceration, and the contact of its fecal contents with the cellular tissue immediately on its outside. (See *Cœcum.*)

The disease usually announces itself by certain *precursory symptoms*, as colic, with alternate constipation and diarrhœa, occurring at longer or shorter intervals, and continuing for a greater or less period. M. Dance states that in a patient whom he has lately attended, these phenomena appeared five or six times in the course of a year, before the iliac tumour made its appearance. After a while the attacks of colic become more severe, and appear to centre in the right iliac fossa; they may also radiate in the direction of the great intestine, or be spread over the whole cavity of the abdomen. These pains are usually attended with obstinate constipation, and sometimes with such violent vomiting as to simulate an internal strangulation. In some cases, the disease, at its origin, is attended with less violent symptoms, and commences with pain in the right iliac fossa. If this region be examined, it will be found more tender to the touch, more resisting, and sometimes to project more than in the natural state. It is frequently possible, by pressing upon the abdominal parietes, to distinguish a circumscribed tumour of variable size, of considerable firmness, more sensible to the touch than any other part of the abdomen, and appearing to rest upon the cœcum; the remainder of the abdomen is soft and indolent. The patient continues at the same time to complain of colic and constipation; there is troublesome flatulence and borborygmy, from the difficulty, and sometimes, impossibility, of discharging the flatus per anum, resulting apparently from the compression of the tumour upon the cœcum, and to the obstacle which this opposes to the passage of gas and feces. Sometimes the fever is pretty intense; but in general the constitutional symptoms are not severe, unless when complicated, the only general symptoms observed being a slight acceleration of the pulse during the paroxysms of colic. The fever and anorexia would therefore seem to belong to the gastric affection; and the constipation and diarrhœa to be accidental, arising from the same cause, or from the greater or less size of the tumour.

The *progress* and *termination* of these engorgements are variable; most frequently, resolution may be effected by a suitable treatment; this is, however, accomplished but slowly. At other times, though happily rarely, the inflammation extends to the peritonæum, and produces death;—M. Dance has met with only a single case of this kind. Finally, these tumours frequently become hot; throbbing pains are felt within them; they increase in size, and sometimes produce a considerable tumefaction in the lower and right side of the abdomen; they soon become soft, fluctuation may be felt in them, and ultimately they open (which is one of their peculiar characters) into the intestines, occasioning purulent stools which continue for a longer or shorter time, coinciding with the disappearance of the iliac tumour. This termination has always been favourable, and in a short time the patients have entirely recovered. It may be understood how these abscesses discharge into the cœcum, when it is remembered that they are situated immediately behind this intestine, at a place where the parietes of this last, not being covered by the peritonæum, are thinnest, and offer least resistance. The intestine being differently disposed on the left side, explains the reason of such a termination not occurring there. These abscesses sometimes open both into the cœcum and bladder or vagina. It moreover, sometimes, though very rarely, happens, that, instead of opening internally, they discharge externally; a very unfavourable occurrence, on account of the most depending part of the abscess reposing in the iliac fossa, whilst its exit is usually in front and elevated, which causes the retention and alteration of the purulent matter. This termination is not always fatal, as M. Dance has lately seen, in two instances. In one case which occurred in the practice of Mr. Ferrall, the matter perforated the os ilium, and the abscess pointed on the dorsum of that bone.

The *diagnosis* of these abscesses can usually be determined, if attention be paid to all the circumstances just noticed. The

antecedent symptoms, their peculiar seat on the right, the manner in which they are developed, and their terminations, are in some degree so many characteristic points. They may be distinguished from deep-seated phlegmonous abscesses, which sometimes occur in the same region, around or in the parenchyma of the psoas and iliac muscles, by the latter being attended with pain when the lower limb of the corresponding size is moved, and the tumour being less exactly circumscribed; the collection of feces in the cœcum, or its distension by flatus, can only deceive the surgeon momentarily; but there may be some difficulty in forming a diagnosis between these abscesses and an incipient intussusception of the small intestine into the cœcum. (See Dance, on Intussusceptions. *Répert. d'anat. et de physiol.* 1827.) Dupuytren has seen them mistaken for hepatitis, metritis, and peritonitis.

In general the *prognosis* is favourable; since, out of sixteen cases collected by M. Meniere, one only has proved fatal. When the symptoms yield readily to the curative methods, the bowels perform their functions, the fever disappears, and the volume of the tumour decreases—a speedy cure may be expected. But when, on the contrary, the symptoms continue; when the tumour, which has been more or less rapidly increasing, becomes now the seat of a fluctuation, obscure at first, then more distinct; and when pulsations with darting pains are present, in this case the evacuation of the matter may be expected by stool; nor need the prognosis be unfavourable; for experience has shown that the cure may not be less effectual or complete in this way, than when resolution has taken place. If peritonitis, however, supervenes, a fatal termination is to be dreaded; for the occurrence of this disorder is to be considered as indicating a rapid increase of the primitive malady, and the combination of both puts the case beyond the reach of art.

The *treatment* of these engorgements and abscesses should be antiphlogistic from their very commencement, and the more active the more the tumour appears disposed to increase. General bleeding, and especially the copious and repeated detraction of blood by leeches, with emollient cataplasms, and repeated and long-continued hip-baths, are usually promptly successful. Enemata and slightly laxative drinks are considered by MM. Dupuytren and Dance as equally useful, by preventing the continuance of feces in the cœcum, and the irritation which their presence may excite there. Active purgatives are, however, to be avoided, as adding to the irritation. Absolute rest and severe regimen should not be neglected. If the pain decrease and the swelling diminishes, indicating the approach of resolution, little more will be required than the emollient applications, and rest and regimen. Calomel, combined, or not, with opium, according to circumstances, Mr. Ferrall considers as highly useful at this period, in promoting the removal of the thickening which surrounds the intestine. But when, on the contrary, notwithstanding these measures, the tumour increases and is converted into a vast abscess, M. Dance advises that no endeavour should be made to draw it to a head and to open it externally; but that the surgeon should wait patiently the discharge of the purulent matter by the intestine. Where this termination does not take place, and where there is a disposition in the abscess to open externally, the matter should be let out by an incision, before the skin breaks, and by proper dressings, and especially a suitable position, the abscess entirely evacuated and its cavity obliterated. As the most dependent part of the tumour is towards the posterior of the body, it has been recommended for the patient to lie on his face. When the disease becomes complicated with peritonitis, the remedies for this latter affection are to be employed.

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3. *Iliac abscess in lying-in women.* M. Dance (*Dict. de Méd.* I. 223.) describes another species of abscess, which frequently supervenes to delivery, and which it is proper to notice here, from their resemblance to the preceding. These are developed between the broad ligaments of the uterus, or more externally upon the iliac fossa, along the crural arch, from the groin to the superior anterior spinous process of the ilium; they occur most com-

monly, but do not exclusively, on the right side, like those of which we have just treated. Their occurring most frequently on the right side, M. Dance conceives to result from the usual inclination of the uterus towards that side during gestation, and to the pressure or tension which is greater upon that side. These abscesses form very soon after delivery, and at their commencement the diagnosis is very difficult; the pain which attends them, and which is felt in the pelvis, may in fact be as well referred to the uterus or to the peritonæum itself, as to the inflammation of the cellular tissue exterior to these parts; however, this pain has a tendency to concentrate itself in the flanc or iliac region of one side, and, notwithstanding its acuteness and persistence, it does not disturb the circulation, like metritis or incipient peritonitis. To the pain, are soon added, tumefaction and tension in the parts indicated, and it is then not unusual for the whole iliac fossa, a portion of the hypogastric region, and even the flanc, to be tumefied, hard, and sensible to the touch. If the disease proceeds, this tumefaction becomes daily more apparent, approaches the skin, becomes soft, fluctuation is perceptible in it, and finally, the abscess, artificially or spontaneously opened, discharges, pours out a great quantity of purulent matter, of rather a sero-albuminous than phlegmonous character. This opening generally takes place near the crural arch, and is generally followed by the evacuation and obliteration of the cavity of the abscess. But in some cases the purulent matter, being disseminated in the pelvis, and not having any easy exit, keeps up a fistulous condition of the opening, and exposes the patient to all the dangers of protracted suppuration; M. Dance has seen in one case this matter make its way into the uterus and discharge through that organ, and, nevertheless, it speedily terminated fatally. Though these inflammatory engorgements have a strong tendency to suppurate, this termination may, according to M. Dance, be prevented by the early recourse to an energetic antiphlogistic treatment. Puzos, in his *Mémoires sur les depôts laiteux*, relates four or five cases which are calculated to prevent our despairing of effecting the resolution of the engorgements under consideration, even after a considerable time has elapsed since their appearance. He treated them principally by the copious and repeated detraction of blood by leeching.

I. Hays.

§ 13. Abdominal Pulsations. These may perhaps all be arranged, according to the causes which produce them, into three species:—1st. those arising from dilatation of the large arteries contained in the abdomen; 2d. those produced by mechanical impediments to the circulation; and 3d. those resulting from causes not as yet well determined, and which have been regarded as dependent upon a nervous affection. The first will be noticed elsewhere, (see *Aneurism of the Aorta*, *Cœliac and Mesenteric Artery*); it is to the consideration of the other two, but more especially the last species, that this article will be devoted.

Abdominal pulsations produced by impediments to the circulation.—We refer to this species, all those pulsations in the abdomen which result from tumours of the mesentery, scirrhus of the pancreas and of the stomach, enlargement of the vena cava, accumulation of feces in the colon, increased solidity of the lungs, adhesion of the pericardium to the heart, and preternatural dilatation or enlargement of the heart. Allen Burns, Albers, the late Professor Warren of Boston, Sewall, and Mott, have enumerated induration of the pancreas among the causes of abdominal pulsations. Taberranus (*Obs. Anat.* Ed. 2. No. 9,) relates a case in which the pulsations were produced by a large scirrhus tumour in the mesentery, so closely connected with the great vessels as to compress the aorta, by the pulsations of which it was raised up; and in Störk's case, quoted by Cooper in his Surgical Dictionary, that symptom arose from enlargement of the pancreas, which weighed thirteen pounds, and contained a large cyst filled with blood. (*Annus Medicus*, Vindob, 1760, p. 245.) Another cause of abdominal pulsations, noticed by Baillie, (*Morbid Anatomy*,) Burns, (*Dis. of Heart*,) Monro, (*Morbid Anat.*) Francis, (*Trans. Lit. and Philos. Soc. of New-York*, Vol. I.) Mott, &c. is a scirrhous condition of the stomach. In Leroux's *Journ. de Méd.* for October, 1815, a case is related, in which this affection was produced by a cancerous tumour occupying the internal surface of the stomach from the duodenum to the insertion of the œsophagus. It is also sometimes occasioned by encysted tumours attached either to the lower surface of the diaphragm, or formed between the layers of the pericardium towards the diaphragm, as was the case in the observation recorded by Lancisi. In a case related by Senac, (*Traité de Malad. du Cœur*,) vio-

lent pulsation in the epigastrium was induced by enlargement of the vena cava, which vessel was dilated to the size of a man's arm; and in an inhabitant of Batavia, who had been afflicted for three years with this pulsation, Bontius states that it was occasioned by a medullary substance which filled the vena cava and pressed upon the aorta. (*De Medicina Indorum*, Lugd. 1718, Lib. IV. Obs. 8. p. 101.) Dr. Parry considers the accumulation of feces in the colon as a very common cause of these pulsations, (*Elements of Pathology.*) The following remark of Mr. Hunter's will explain how an artery, which is not dilated, can communicate to a tumour in contact with its parietes such movements as are frequently remarked in cases of abdominal pulsations. (Cooper's *Surg. Dict.*) In speaking of the actual dilatation of an artery, he says, that when the vessel is "covered by the integuments, the apparent effect is much greater than it really is in the artery itself; for in laying such an artery bare, the nearer we come to it, the less visible is its pulsation; and when laid bare, its pulsation is hardly to be either felt or seen." (*Treatise on the Blood.*) Increased solidity of the lungs, more especially of their lower acute margins where they lay over the pericardium and in contact with the diaphragm, according to Allen Burns, gives rise to a pulsation in the epigastric region; the stroke of the heart against the solid lungs causing the impulse to be felt in the epigastrium, through the medium of the sternum or anterior surface of the left lobe of the liver. The only case of this kind on record is, we believe, that related by Mr. Burns; and he describes the pulsation as having been very violent, and distinctly visible externally. (*Dis. of the Heart, &c.*) Disease or malformation of the tricuspid valves, or a preternatural dilatation of the heart, or of its right side only, are known to give rise to the same phenomena. (Mott, *Trans. Phys. Med. Soc.*) Morgagni (Epist. 17. art. 28,) states, that sometimes in dilatation of the heart, this organ descends so low as to push the diaphragm into the hypochondrium, and pulsate in that situation, so that the disease is mistaken for an aneurism of the cœliac artery. Allen Burns relates a remarkable case of this kind, and another is quoted in Cooper's Surgical Dictionary from the Medical Intelligencer for 1821. An erroneous judgment is the more likely to be formed in examples of this description, since the pulsations of the heart and tumour are not simultaneous; for it is not the heart that is directly felt beating, but the liver, which by the action of the heart is thrown forwards. Hence the appreciable interval between the stroke of the heart and the movement of the liver. According to A. Burns, (*O. C.* p. 263,) a beating is generally felt about the pit of the stomach, in the advanced stage of chronic inflammation of the heart: in this case, when the pericardium is closely adherent to the latter organ, it is corrugated at every contraction of the ventricles, and the diaphragm and liver are elevated. The ventricle, however, having completely emptied itself, is again distended, and, in proportion to the degree of dilatation, the liver and diaphragm descend, whereby an impulse is communicated to the epigastric region. Two cases of this description are recorded by Professor Mott. (*Op. Cit.* I. 364.)

The *treatment* of these cases must of course depend upon the primary disease of which they are the result, and will be more appropriately considered in the articles devoted to those diseases.

Abdominal pulsations resulting from causes not as yet well determined, and regarded as dependent upon a nervous affection.—These pulsations are for the most part perceived principally at the epigastrium, and occasion there a throbbing, and sometimes a tumefaction, calculated to lead to a belief of the existence of an aneurism of the cœliac artery. They frequently extend also along the aorta even as far as the iliacs. In persons who are not very fat, when lying on their backs, the pulse of the aorta can always be easily detected, if pressure be made a little to the left of the median line, about half-way between the navel and scrobiculus cordis; and in certain cases this pulsation is painfully felt by the patient himself. This occurs most commonly about the middle period of life, and appears to be more frequent in females than males. It is in nervous and hypochondriac persons, individuals labouring under derangements of digestion, who are subject to hemorrhoids, and in hysterical females, often after an obstruction or suppression of the menses, that this affection has been most frequently observed. Zuliani, (*De Apoplexia*, Lips. 1790, p. 79,) Pinel, (*Nosog. Phil.*) Albers, (*Ed. Med. Surg.* III. 12.) Senac, (*Traité des Malad du Cœur*,) De Haen, (*Heilungs Methode, uberstebzt-von Plantner*, Leip. 1782, b. 2. s. 29.) &c. describe these pulsations as a common attendant upon hypochondriasis. Dr. Albers relates the case of a man about forty years of age, severely afflicted with hypochondriasis, at-

tended with oppression, tendency to fainting, complete sleeplessness, &c. in whom a very strong pulsation could be felt along the whole course of the aorta, and even in the left iliac. After the use of gentle purgatives, and the discharge by stool for several days of a pitchy black matter, the above symptoms ceased, and the pulsation abated, but continued perceptible for nine months afterwards. This affection is well known to be a frequent attendant upon various disorders of the digestive organs. LEWENHOECK relates a case which lasted three days, during which the digestive organs were much disordered. (*Philos. Trans.* Abr. VII. 683.) The following case is related by Dr. ALBERS. A young woman, whilst menstruating, and who had been for some days constipated, was seized with fainting fits and febrile symptoms, occasionally voiding from her bowels a quantity of black matter, each evacuation of which was followed by a swoon. One morning at five o'clock, Dr. ALBERS was sent for, as the patient was believed to be dying. She was extremely exhausted, and the fainting fits succeeded each other almost without intermission. She was only able to tell, in an under voice, that she felt a palpitation in her belly; and when Dr. ALBERS applied his hand to the part, he felt a violent pulsation extending from the ensiform cartilage to almost the bifurcation of the aorta. "The pulsation of the *heart* was *weaker than natural*, the pulse at the wrist extremely small, and not synchronous with the pulsation in the abdomen." Dr. ALBERS and Mr. MEYERHOFF at first believed the patient to be affected with aneurism; but Dr. WEINHOLT, recollecting some similar cases recorded by MORGAGNI, entertained a different opinion, and recommended perseverance in the employment of laxatives and clysters, combining some opium with the former. Under the use of these remedies, in a few days the pulsation in the abdomen and tightness of the chest diminished. The stools were at first of the colour of chocolate, but afterwards resumed their natural appearance. In a short time the patient got well, and remained so several years afterwards. (*Ed. Med. and Surg. Journ.* III. 8.) THILENIUS, (*Med. Chir. Bemerk.* Frankf. 1789. s. 211—217,) and Mr. HODGSON, (*On the Diseases of Arteries and Veins*, p. 96,) notice these pulsations as occurring in persons affected with a flatulence of the stomach. HAU, (*Diss. de Gastrodynia*, Upsal, 1797,) has met with them in cases of gastrodynia. Professor CHAPMAN, in his lectures, states, that he attended a female in whom the pulsations were so violent as actually to raise up the bed-clothes. They appeared to depend upon disordered digestion, and were cured by remedies directed to that affection. ALBERS has met with these pulsations in cases of hemorrhage from the intestinal canal; and he says that hemorrhoidal patients, especially when inconvenienced by compression of the tumours, often complain of throbbings about the spleen, which are distinctly perceptible to the touch; and pulsations in this last situation were also experienced in a labourer who was subject to bilious attacks, and whose case is narrated by TULPIUS, (*Obs. Med.* Amst. 1652. Lib. II. Chap. 28.)

MORGAGNI (Epist. 39. art. 18.) describes the case of a woman forty-four years of age, who, after a suppression of the menses for some months, was attacked with palpitations in the epigastrium; and there was an obstruction of the menses, in one of the cases mentioned by HIPPOCRATES. Dr. ALBERS has seen these pulsations supervene at the commencement of pregnancy and recur at every new gestation. He reports (*Loc. Cit.* p. 11.) a case in which this was so constant that the woman relied upon that sign in preference to all others. The pulsation was sometimes so violent that the husband assured Dr. A. that it might be heard distinctly. It ceased usually after the third month. SENAC (*Trait. des Malad. du Cœur.*) has met with the affection under consideration, in chlorotic patients, and it is often present in hysterical women. ALBERS, (*Loc. Cit.* p. 12.) &c. Professor MOTT relates (*Loc. Cit.* p. 356.) a very interesting case occurring in a female twenty years of age, of sanguine temperament, and very delicate and irritable habit; the mother of two children; who constantly since her marriage had been subject to attacks of hysteria, great difficulty of breathing, with a most frightful sense of suffocation, great palpitation of the heart, and a distressing throbbing of the arteries of the head and superior extremities. During convalescence after the birth of her second child, she was suddenly attacked with a strong pulsation in the epigastrium, opposite to the origin of the cœliac artery. This pulsation was synchronous with the action of the heart, could be seen externally, was unattended with any tumour, and was most violent in the afternoon and evening. Tonics and antispasmodics, gentle and regular exercise, and a residence in the country, improved her health, and the pulsation entirely left her.

In a case related by TEALE, (*Treatise*

on neuralgic diseases, Case XIII.) pulsation of the epigastrium was attendant upon spinal irritation, and we have also met with it in cases of a similar character.

All these facts seem to indicate that the pulsations under consideration are really dependent upon some nervous affection. M. Dance inclines to the belief that the solar plexus and its ramifications have something to do with their production, and he quotes, in support of this, an experiment of Sir Everard Home instituted with the view of determining the influence of the nerves upon the arteries. Mr. H. having laid bare the carotid artery of a rabbit, applied caustic potash upon the neighbouring branches of the great sympathetic, which soon caused a violent beating of the artery. (*Trans. Roy. Soc. Lond.* 1814.) We are led, ourselves, to believe that they are, for the most part, somehow dependent upon spinal irritation, from having seen them in connexion with that affection, and from the striking similarity between the accompanying symptoms and those attendant upon that disease. A comparison of the cases to which we have just referred, with those related by Teale in his admirable work on neuralgic diseases, will bear us out in this opinion. It is not easy, however, to explain the precise mode of connexion between the cause and effect in these cases.

The *diagnosis* may generally be determined by attention to the following circumstances. These pulsations often vary in force and frequency, appear suddenly, and disappear in the same manner, and are not always synchronous with those of the heart. In aneurisms, auscultation shows an increase in the calibre of the artery; and the pulsations caused by an impulse communicated by the arteries to a tumour, arise gradually, increase in the same manner, and they are synchronous with those of the heart; and this last is also the case in aneurisms.

These pulsations being merely a secondary affection, the *treatment* must be directed to the cure of the primary disease. When this last is spinal irritation, the treatment proper for that affection, (*q. v.*) as, the local detraction of blood by cups or leeches, followed by blisters or tartar emetic ointment to the spine, are to be employed. When connected with dyspeptic symptoms, with hypochondriasis and hysteria, the treatment calculated to remove those complaints (*q. v.*) is to be resorted to. In the hypochondriacal patient whose case is related by De Haen, the pulsations were cured by active opening medicines; and in two cases related by Albers, in which there had been previous constipation, the pulsations ceased under the use, continued for some days, of mild purgatives, which evacuated a quantity of dark matter from the bowels. In the female whose case we have quoted from Morgagni, and in whom these pulsations succeeded to suppression of the menses, they were promptly cured by bleeding. Cold baths, mild tonics, and moderate exercise, will also be found useful in some cases.

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I. Hays.

ABDUCTORS. (From *abduco*, to draw away.) *Abductor*, Lat. *Abducteur*, Fr.

This name is given to certain muscles, the office of which is to draw the member to which they are affixed from some other. (See *Muscles.*) I. H.

ABEPITHYMIA. (From α priv. and Επιθυμία, an active principle situated in the abdomen, according to Plato.) Lobstein employs this term to signify a paralysis of the solar plexus. It is used also to indicate death from the cessation of the influence of the abdominal viscera upon the nervous system. I. H.

ABERRATION. (From *aberrare*, to wander from.) *Aberratio*, Lat. *Aberration*, Fr.

Used to express every anomaly in the situation or condition of the animal fluids, or in the form, position, texture or functions of the organs, either physiological or pathological. It is applied, in pathology, to the passage of fluids into an order of vessels in which they are not destined to flow, as the passage of red blood into the lymphatic vessels; and also the determination of a humour to an organ to which it is not usually directed, as when the menstrual fluid is discharged from the mucous membrane of the nose or lungs. When there exists a defect in the images perceived or in the judgment formed, it is termed an aberration of sense or judgment. This term has no precise meaning,

and should therefore be banished from medical language. I. HAYS.

ABIES. FIR and SPRUCE.—*Sapin*, Fr. *Tanne*, Germ.

Sex. Syst. Monœcia Monadelphia. *Nat. Ord.* Coniferæ.

Gen. Ch. MALE. *Anthers* two-celled. FEMALE. *Scales* imbricated in a round cone, bracteate at base, digynous. *Pericarps* attached to inside of scale, winged, deciduous. *Stigmas* two or three cleft. *Cotyledons* three to nine. *Lindley.*

This genus was separated from the Pinus of Linn., and is at present recognized by perhaps the majority of botanists as distinct; although by many its species continue to be associated with the pines, to which they are closely allied in botanical character. The firs and spruces are beautiful evergreen trees, with their branches usually verticillate and horizontal, and assuming, when allowed to expand freely, a pyramidal form. Their leaves differ from those of the pines, in being solitary, and distinct at their base. Their male aments, moreover, are simple instead of being branched, and the scales of the cone are flattish, thin, and not swelled at their summit. The following species yield products employed in medicine.

1. *A. Balsamea.—A. Balsamifera*, Michaux.—*Pinus Balsamea*, Linn.—*American silver fir. Fir balsam. Balsam of Gilead.* — *Pin baumier*, Fr. *Balsamtanne*, Germ.—*Sp. Ch.* "*Leaves*, solitary, flat, emarginate, subpectinate, suberect above. *Scales of the cone* in flower acuminate, reflexed." *Lindley.* This tree is a native of North America, growing in Canada, Nova Scotia, New Brunswick, and the northern parts of New England, and extending along the Alleghany ridges as far southward as North Carolina. It is of middling size, seldom exceeding 40 feet in height, with a trunk a foot in diameter near the base. The branches are numerous, and thickly covered with leaves, which are from six to eight lines long, narrow, rigid, flat, of a bright green colour on their upper surface, and a silvery whiteness beneath. The cones are nearly cylindrical, four or five inches long by an inch in diameter, erect, and often covered with a resinous exudation which gives them a shining appearance. This tree yields the *Canada turpentine*, known more commonly by the erroneous name of *Canada balsam*, and occasionally called *balsam of fir.* (See *Turpentine, Canada.*)

2. *A. Canadensis.—Pinus Canadensis*, Pursh. — *Hemlock spruce.* — *Sp. Ch.* "*Leaves* solitary, flat, toothletted, somewhat distichous. *Cones* ovate, terminal, scarcely longer than the leaf." *Lindley.* This species of Abies is indigenous, abounding in Canada, New Brunswick, Nova Scotia, and New England, and flourishing also in the more elevated districts of the middle States. It attains a height of seventy or eighty feet, with a trunk six or eight feet in circumference, and of nearly uniform dimensions for two-thirds of its length. When young, it has a beautiful appearance, from the symmetrical arrangement of its close horizontal branches, and the density of its foliage; but, as it becomes older and more brittle, the same causes tend to mutilate and disfigure it, by the frequent breaking of the branches under the weight of snow with which they become loaded in winter. The leaves are six or eight lines long, flat, numerous, and irregularly disposed in two rows. The cones, which are rather longer than the leaves, are ovate, and hang downwards at the ends of the branches. The bark of the hemlock spruce contains much tannin, and is employed as a substitute for that of the oak in the preparation of leather; but to the physician the tree is interesting chiefly as the source of the *hemlock pitch*, or, as it is commonly called, *hemlock gum*, which spontaneously exudes and hardens upon its bark. (See *Pitch, hemlock.*)

3. *A. communis.—A. excelsa*, De Candolle. — *Pinus Abies*, Linn. — *Norway spruce fir.* — *Pesse, epicea, faux sapin*, French. — *Gemeine Tanne, Rothtanne*, Germ.—*Sp. Ch.* "*Leaves* solitary, four-cornered. *Cones* cylindrical. *Scales* rhomboid, flattened, repand at end, eroded." *Lindley.*—This is a very large tree, growing abundantly in Norway, Sweden, Russia, and the north of Germany, and found in the mountainous regions of France, Italy, and Spain. It sometimes attains the height of 150 feet or more, with a trunk from three to five feet in diameter. Its branches, which spring from the lofty erect trunk in a verticillate manner, are thickly clothed with a dark green foliage, and frequently drooping somewhat towards the earth, give a funereal aspect to the tree. It affords turpentine by incision, and is one of the sources of *Burgundy pitch*, which is also obtained from the *Abies Picea.* (See *Pitch, Burgundy.*) Another product of the tree is the *resina abietis, thus*, or *frankincense* of British pharmacy. This is in brittle grains or lumps, brownish yellow on the outside, white within, and of an agreeable resinous odour. It is frequently employed on the continent of Europe as incense in the churches, on ac-

count of the pleasant odour it emits when burnt. It is not used in this country. For medical purposes, perfectly dry, hard, and brittle pieces of the white turpentine of the shops, may be substituted without disadvantage. The tops or young branches of this species, and of the *A. Picea*, are used in Europe for flavouring beer, in the same manner as those of the black spruce in this country.

4. *A. nigra.—Pinus nigra*, Pursh.—*Black spruce.* *Sp. Ch.* "*Leaves* solitary, four-cornered, erect, straight. *Cones* ovate. *Scales* elliptical, wavy at edge, erect." *Lindley.* The black spruce is an indigenous species, inhabiting the same regions with the *A. Canadensis*, with which it forms immense forests in the north-eastern section of our country. It has a smooth perpendicular trunk, gradually tapering to the summit, and attaining, in its fullest development, the height of 70 or 80 feet. The branches are horizontal, and in insulated trees arranged so as to form the pyramidal summit common to all the species. The leaves are about four lines long, of a dark dusky green colour, firm, numerous, and attached irregularly over the surface of the branches. The fruit is a reddish, ovate cone, pointing towards the ground, and from eight lines to two inches long. This is the tree of which the young branches are used in this country for the preparation of *spruce beer*. A decoction in water is first formed, and then made to ferment by the addition of a due proportion of sugar or molasses, and yeast. The preparation kept in the shops under the name of *essence of spruce* is prepared by evaporating the decoction of the young branches. It has usually the colour and consistence of molasses, with a bitterish, astringent, acidulous taste. It is much employed, as a substitute for the branches themselves, in the preparation of beer. The following is a formula recommended. Take of essence of spruce *half a pint;* pimento bruised, ginger bruised, hops, each, *four ounces;* water *three gallons.* Boil for five or ten minutes: then strain, and add of warm water *eleven gallons;* yeast *a pint;* molasses *six pints.* Mix, and allow the mixture to ferment for twenty-four hours. This is a wholesome and pleasant drink in warm weather, and occasionally beneficial in chronic debility of the digestive organs. It is said to be useful in preventing scurvy, for which purpose it is sometimes used on long voyages.

5. *A. Picea.—A. pectinata*, De Candolle.—*Pinus Picea*, Linn.—*European silver fir.* — *Sapin commun, sapin argenté*, French.—*Weisstanne, Edeltanne*, Germ. — *Sp. Ch.* "*Leaves* solitary, flat, emarginate, pectinate. *Scales of cone* very blunt, appressed." *Lindley.*—This is a native of Europe, growing throughout nearly all Germany, and in the mountainous districts of France and other parts of the continent. It bears a close resemblance to the *A. Balsamea* or American silver fir, but is a much larger tree, attaining, it is said, in some instances, the height of 150 feet, with a trunk six feet in diameter. Like the American species it has a silvery aspect, derived from the white colour of the under surface of the leaves. It is rich in juice, and furnishes the same terebinthinate products as those obtained from the pines. The substance known in Europe by the name of *Strasburgh turpentine* is obtained from it; and it contributes to furnish the *Burgundy pitch* of commerce. (See *Turpentine, Strasburgh*, and *Pitch, Burgundy.*) The *buds* are used in medicine, and are kept in the shops of continental Europe. They abound in a resinous matter, which often exudes upon their surface in the shape of small tears. In medical properties, they resemble the turpentines, being considered antiscorbutic, tonic, and diuretic. One of the authors of the *Dict. Univ. de Mat. Med.* has often successfully used their infusion, in the proportion of from two to four drachms to a pint of water, in the treatment of chronic leucorrhœa. He continues the medicine for one or two months. The buds of other firs, and of some pines, are occasionally substituted, and, as they have similar properties, without disadvantage. The tops, like those of the Norway spruce fir, are used to flavour beer; and the young branches of both species are said to exude a kind of manna.

Other species of Abies are, the *A. Fraseri*, *A. alba*, and *A. rubra*, of North America; and the *A. orientalis*, of the Levant; but as these yield no medicinal products, they do not merit particular notice in this place. The *A. rubra*, or *red spruce*, is maintained by Michaux to be merely a variety of the *A. nigra*, and may possibly be employed like it in the preparation of essence of spruce. The *A. alba*, *white spruce*, or *single spruce*, is cultivated in France, where the buds are said to be sometimes kept in the shops instead of those of the silver fir.

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ABIRRITATION. (From *ab*, priv. and *irritatio*, irritation.) This term has been employed by Broussais and his school, to denote a diminution of the vital phenomena in the different tissues. (See *Irritation.*)

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I. H.

ABLACTATION. (From *ab*, priv. and *lacto*, I suckle.) The absence or cessation of lactation, (q. v.) This word, as originally employed by the Latin writers, was synonymous with our term *weaning*, (q. v.); but it has been restricted by some modern writers to this process as it relates to the mother. I. H.

ABLATION. (From *auferre*, to remove.) Formerly employed in a very extensive signification, and expressed the subtraction of whatever was in excess, in the body; the reduction of regimen; and the diminution of the mass of blood, by bleeding, &c. Its meaning has been much restricted by the moderns; and it is now principally used in surgery, as a generic term, expressive of all cases where a part is taken away. It includes two species, *Amputation* and *Extirpation*, (q. v.)

I. H.

ABORTION. *Abortus*, *Aborsus*, *Affluxio*, Lat. Αμβλωμα, εξαμβλωσις, Hip. Διαφθορα, ἐκτρωσμος, Aristot. *Avortement*, Fr. *Aborto*, Ital. *Falche Geburt*, *Fehlgeburt*, Germ. *Miscarriage*, Eng. The premature expulsion of the contents of the uterus after conception.

Art. I. Abortion. (*Obstetr.*) The contents of the uterus may be expelled, from the first few weeks after impregnation to the full period of utero-gestation. But the term Abortion, is usually confined to such cases of expulsion of the ovum, as happen before the fifth month; after this period, to near the full term, it is usual to call this accident by the name of *Premature Delivery*, (q. v.)

Causes.—Any thing capable of exciting uterine contraction to a certain degree, may be considered as a cause of abortion: these may be all mechanical violences; passions and emotions of the mind; sudden alarm; drastic purgatives; almost all the exanthemata, especially small-pox and scarlatina; peculiar conditions of the uterus itself, or of its connexions with the vagina, as first made known to the public by Madame Boivin, though not first observed by her; syphilitic taint; a rheumatic condition of the uterus itself; local plethora; the death of the fœtus, &c.

Some of the causes just enumerated, for instance, mechanical violences, are perhaps the most common; such are blows, falls, slips, over-exertion, &c. The next in frequency, are passions and emotions of the mind, alarms, &c.; while the peculiar condition of the uterus, as regards its condition with the vagina, and other portions of the lower part of the pelvic cavity, and rheumatism, are the most rare—the former seldom or never occurring but with such women as have had many children, or such as have been maltreated during labour, or who have suffered numerous abortions; the latter, only, perhaps, taking place from premature exposure to cold after delivery or abortion.

There is much diversity in the influence of the causes of abortion, owing, most probably, to a more or less healthfulness of the uterus itself. In some instances, the slightest of the enumerated causes will be followed by unappeasable contractions of the uterus; while in others it requires that they should be applied with great force to produce similar consequences.

Where organic derangements of the uterus exist, abortion takes place with great uniformity at a certain period of utero-gestation. In such cases, the uterus will not suffer distension beyond a certain degree, without being excited to contraction; because its organization is so deranged, as not to permit of distension without causing uterine contractions. The same effect is pretty constantly observed in the rheumatic condition of this organ.

Local plethora, in many instances, becomes a cause of abortion: this is most frequently observed in women with whom abortion becomes a habit; hence the frequency of this accident in certain females, even to the amount of a dozen consecutive times. This act readily establishes itself as a habit, because each time it takes place the uterus becomes the more readily disposed to plethora. That the fœtus may become diseased and die in utero, even at an early period of gestation, is supported by many facts; and when this is constitutional, as it sometimes is, the woman suffers abortion as certainly as impregnation takes place.

It has just been stated, that uterine contraction is essential to the throwing off of the ovum; and that the remote causes all tend, with more or less certainty, to produce this effort of the uterus. If this be admitted, there will be but little difficulty in explaining the symptoms that attend this accident.

Symptoms.—It rarely happens that abortion, or the disposition of the uterus to cast off its contents, is not preceded by pretty uniform phenomena: as, more or less pain in the back and loins, with a sensation of bearing down; lassitude; depression of spirits; and a more than natural disposition to make water. These symptoms are generally sooner or later followed by a "show," or a slight discharge of blood from the vagina, which will very soon, in some instances, amount to an hemorrhagy. Sometimes, and not very unfrequently, this "show" is the initial symptom; or, the aborting effort may commence by a sudden, and even an alarming discharge of blood; this especially happens to such as have had frequent repetitions of this accident.

The blood is expelled in coagula, or in a current, as the separation of the ovum is more or less extensive; or as the point of separation may be more or less remote from the os uteri; for a separation of the connecting medium of the ovum and uterus is a sine qua non to hemorrhage; at least, until after, perhaps, the sixth month. For up to this period, or nearly to this time, the ovum is almost entirely attached to the internal parietes of the uterus by the decidua and decidua reflexa, which subserves the offices of the placenta; but beyond this period, so much of the transparent portion (the membranes) of the ovum is formed, as to line a considerable part of the uterus; but from the detachment of which, no hemorrhage follows immediately, though eventually this separation may involve that of other portions, and thus produce a flooding of greater or less extent.

A flooding, however, is not a uniform attendant upon abortion; for the ovum is occasionally thrown off without this oftentimes alarming symptom; this, however, is confessedly rare, and perhaps only happens where no union was formed between the ovum and the uterine cavity.

Pain, like that of genuine labour, almost always accompanies abortion. At this we need not be surprised, as the action of the fundus and body of the uterus has to overcome the resistance of the neck of that organ, before the ovum can be expelled; and this is sometimes only accomplished by long-continued and frequently-repeated uterine efforts, and these oftentimes of the most painful kind.

At other times, this act is effected with very little suffering, or with a trifling expenditure of blood. This is more frequently the case with women who abort habitually.

The mammæ frequently sympathize with the uterus during the progress of abortion, or previously to its commencement. In the first instance, they become painful and a little swelled, if the process be slow and not very painful; in the second, it happens from the loss of vitality of the embryo or fœtus: when this takes place before any other symptom shows itself, it becomes the cause of uterine contraction; as the ovum now, from its loss of life, constitutes an extraneous body within the uterine cavity. These cases are rarely attended by as much pain, or by so great an expenditure of blood, as where abortion is suddenly produced by other causes, and where the ovum maintains its vitality perhaps to almost the last moment.

It is probable that the ovum has been deprived of its vitality in all such cases of abortion, as are attended, or preceded, by diarrhœa; and that those who have enumerated this condition of the bowels among the causes of abortion, have mistaken an effect for a cause; for however strongly the sympathy between the rectum and uterus may be insisted on, it must as confidently be declared, that it is reciprocal; and consequently, that the uterus, in such cases, may have been the original seat of irritation. This opinion is strengthened very often by the state of decay of the ovum at the time of its expulsion, but especially by the previous condition of the mammæ in such instances, as they are sure to have been tumid, and then to have become flaccid, before the escape of the ovum.

Sometimes, the first threatening of abortion is the sudden jet, or escape, of the liquor amnii. This, however, is rare, until after the sixth month, though it occasionally happens as soon as the second month. Uterine contraction and hemorrhage are sure to follow at no very distant period, and forbid success to any effort to prevent the expulsion of the other contents of the ovum.

The degree of hemorrhage is not always in the ratio of the advancement of gestation; though generally speaking, under similar circumstances it may be laid down to be the case; for the loss of blood, for the most part, is governed by the period of conception, the force of the remote cause, the degree or extent of detach-

ment, the vigor of the general circulation, the period that elapses before uterine contractions can be successful in the expulsion of the ovum, and the state of the ovum, that is, whether it remains entire, or has been forced open so as to expend the liquor amnii. Nor is pain always an attendant upon abortion, as many cases have occurred without it, though uterine contractions must take place.

Diagnosis.—The only complaint with which abortion can be confounded, is amenorrhœa when about to be relieved; but there is no very great difficulty in ascertaining the true nature of the pain and discharge of blood, especially in the married woman.

The married woman is rarely liable to suppression of the menses, without its having been preceded, by some pretty evident cause, as exposure to cold or wet, or some chronic disease, especially phthisis pulmonalis; or it may happen at that period of life at which the menses are preparing to take their final leave. When the first of these causes has produced the suppression, the married woman suspects herself to be pregnant, if she pass the common menstrual period, without bearing in mind at the moment, that she has exposed herself to any but the common or natural cause for this interruption. In these cases, nature very frequently overcomes the difficulty, after the obstruction has existed for two or three periods. The reappearance of the catamenia may now be mistaken for a threatening abortion; and the woman gives so effectually into the belief herself, that she immediately takes every precaution to prevent it.

In this case, for the most part, there has been none of the remote causes operating to produce abortion; though this would not with certainty betray the exact nature of the discharge, as abortion often takes place without any evident cause. The discharge, however, is not exactly alike in both instances. In abortion, we almost always have coagula expelled: not so, when it is merely the catamenial discharge. In abortion, the discharge is generally more suddenly abundant, and may be repeatedly arrested for a short time; whereas, in the menstrual evacuation, it is pretty uniformly continuous. Abortion is most frequently attended by alternate pains, which gradually augment, both in force and frequency: this rarely happens with the catamenia; for should the patient have pain, as in dysmenorrhœa, it gradually abates in its intensity, especially after the expulsion of a coagulum, or of a membranous substance; and if the woman have been subject to this form of menstruation, there is much less reason to suspect pregnancy; and consequently, we may doubt that she is about to miscarry.

In pregnancy, other signs present themselves beside the mere arrest of the menstrual discharge: such is morning sickness, increase of the abdomen, enlargement and tenderness of the mammæ, &c.

But after the third month, an examination per vaginam will almost always dispel the doubt, should any exist, especially if the flooding be attended by pretty severe and long-continued pain. This examination should never be omitted in cases of doubt, or where the symptoms have been of long continuance, as it will not only lead to a knowledge of the true nature of the complaint, but will furnish important indications; for if the mouth of the uterus remain undisturbed, it will encourage attempts to preserve the ovum; but on the other hand, if it be distended, or open, it will declare the insufficiency of every attempt to save the ovum. The difficulty in distinguishing the two conditions of the uterus, will diminish in proportion to the supposed advancement of pregnancy.

Prognosis.—The prognosis in abortion, will always depend upon the extent of the hemorrhage that may attend the process; and consequently will not differ from any other extensive loss of blood from the uterus, or even from other portions of the body.

Treatment.—The treatment of abortion will necessarily divide itself into general and local; and the indications must be taken from the immediate condition and habits of the patient; and will consist of attempts to prevent or subdue uterine contraction, and abate hemorrhage.

As uterine contraction must necessarily precede hemorrhage, the endeavour should be to interrupt, or overcome, the action of the uterus as early as possible, by rest in a horizontal position, by blood-letting, by opiates, a strict antiphlogistic regimen, and certain astringents.

1. *Rest.* This is essential to the successful treatment of threatened abortion; therefore, when a pregnant woman is exposed to either of the remote causes enumerated above, and this of sufficient force to excite anxiety for the welfare of the patient, she should be immediately cautioned against every circumstance that may tend to aid the operation of this cause, and be ordered to her bed, that the system may become tranquillized by a supine posi-

tion and perfect rest. This, however, may not always be sufficient of itself to intercept or subdue uterine contraction; it may therefore require the abstraction of blood from the arm as early as may be judged expedient.

2. *Blood-letting.* It rarely happens that this remedy can be dispensed with in habits disposed to be plethoric, and is often of singular benefit in opposite temperaments, when arterial action is roused beyond the healthy bounds; the loss, therefore, of a few ounces of blood is absolutely necessary, when there is a painful aching in the back, a heaviness about the loins, a sense of weight or bearing down, even without pain, but *especially* when there is pain, and when there may be a "show" from the vagina. The loss of eight or ten ounces of blood from the arm, and a strictly antiphlogistic regimen, will not only tend to tranquillize the circulating system, but will prepare the way for the employment of opiates.

3. *Opiates.* Opium, in some form or other, is oftentimes of the highest consequence, and should never be omitted after the system is properly prepared for it by rest, and, if necessary, by blood-letting. Much judgment is, however, required for its exhibition, that it may not do injury. It should never be given when the pulse is highly excited, or when its operation is habitually unfriendly to the system. In the first instance, it should be preceded by rest and the loss of blood; in the second, the Ext. Hyosciam. may be substituted with much advantage. In such cases this remedy should be given in proper quantities to calm the system; and it must be repeated in sufficient doses, and at proper intervals, to overcome uterine contraction. It may be administered by the mouth; or by the rectum, in the form of injection, or suppository.

The use, however, of opium has its limit; for it must not be persevered in after it is ascertained that it would be neither useful nor practicable, to subdue uterine contraction; and this must be ascertained by an examination per vaginam, as recommended above, and if the os uteri be found open, or the neck distended, it would be hurtful to persevere with the opium; or when the mammæ have become suddenly flaccid, after having been distended and painful, it would be found equally useless; for in this instance, the embryo, or fœtus, has certainly lost its life, and it would be mischievous to interrupt pains, as it is by their agency alone that the lifeless ovum can be expelled; and the quicker this is done, the better for the safety of the mother.

4. *Regimen.* It would, in many instances, be altogether unavailing to attempt preventing abortion by the means above suggested, if they were not aided by a proper diet. This is too commonly supposed to be a matter of no moment in the treatment of abortion; but this is an error of great magnitude, and it should not be lost sight of that it is so. None other than the blandest vegetable substances should be given, and these without any seasoning; therefore, every species of liquor, or even spices, should be prohibited, during the active, or commencing stage of abortion. Water, toast-water, barley-water, gum-water, or weak lemonade, should alone be given as drinks; and even these should be administered with a proper regard to the rest, or absence of motion, of the patient.

5. *Certain astringents.* The astringents most to be relied upon are the acetate of lead, the extract of rathany, and red rose-leaf tea. The acetate of lead may be given in doses of two to six grains, every hour or two, guarded by opium, as the hemorrhage may be more or less alarming. If it offend the stomach, it can be given per anum in form of an injection. Twenty grains of the acetate, sixty drops of laudanum, and two or three ounces of water, will be the proper proportions. Six or eight grains of the extract of rathany may be given every hour or two, drinking after it a wine-glass full of red rose-leaf tea, made as follows; half an ounce of the leaves must have a pint of boiling water poured on them and allowed to stand—strain off a wine-glass full, as wanted—it may be sweetened, if preferred. If there be pain when the rathany is exhibited, it will be proper to aid it by opium, as above directed.

Local treatment. This only becomes necessary when an hemorrhage is present; and as this will differ in degree, it will require remedies proportionate to its extent. These applications will consist of cold water, vinegar, or brandy; the tampon, and the crotchet.

The cold wet applications are placed upon the lower part of the abdomen and vulva—their coldness may be increased, if desirable, by the addition of ice. These appliances are oftentimes highly useful, but must not be carried too far—that is, to the prostration of the system; therefore, when the pulse becomes feeble, concentrated, and frequent, the cold remedies should be desisted from, and not repeated

until the system shows a disposition to re-act. During this time, the feet and legs should be kept warm by artificial means.

The tampon must be resorted to, as soon as the flooding becomes rather excessive —a piece of soft sponge of sufficient size is the best, and should be introduced into the vagina after lubricating it well with melted hog's lard; it should not remain longer within the vagina than twelve hours without being changed. It must not be crammed into the passage with such strictness as to obstruct the flow of the urine; and it should never be introduced into the neck of the uterus. This is certainly the most efficacious means of arresting this kind of hemorrhage; and its employment must not be too long delayed.

The crotchet consists of a piece of steel of the thickness of a small quill at its handle, and gradually tapered off to its other extremity which is bent to a hook of small size. (See accompanying figure, which represents the instrument one third the natural size.) This instrument is highly useful in cases in which the flooding continues after the ovum has been broken and its contents expelled. A portion of the involucrum sometimes insinuates itself into the neck of the uterus, and prevents the degree of contraction necessary to interrupt farther bleeding. This accident most frequently attends the earlier abortions. As hemorrhage is maintained by the cause just named, it suggests the propriety of never breaking the ovum; especially before the fourth month. When the flooding is maintained by this cause, it will not cease but upon the event of its removal. This condition of the placenta and neck of the uterus is easily ascertained by an examination; it will readily be felt to be embraced by the neck of the uterus; and though a portion may protrude a little distance below the os tincæ, it cannot be extracted by the fingers; for the os uteri or cavity of the uterus will not be sufficiently large to permit the fingers to pass into it, that this mass may be removed; the crotchet should then be substituted; the mode of using it is as follows: The fore finger of the right hand is placed within or at the edge of the os tincæ; with the left we conduct the hooked extremity along this finger, until it is within the uterus; it is gently carried up to the fundus, and then slowly drawn downwards, which makes its curved point fix in the placenta; when thus engaged, it is gradually withdrawn, and the placenta with it. In every case in which I have used it, the discharge has instantly ceased.

Prophilaxis. It has been noticed above, that aborting frequently becomes habitual —and when it is so, it has been found very frequently difficult to interrupt it, unless very rigid and exact means be employed. The following plan will almost always succeed, if regularly pursued.

1st. The patient must be confined to her bed, or preferably to a mattress, as quickly as practicable after she overruns a menstrual period. On this she must content herself to remain, almost without motion; but certainly without exertion.

2d. She must lose, by leeches or cupping, about four or five ounces of blood, from the inner side of the thigh, four or five inches above the knee, the week previously to the next menstrual period; and this operation must be repeated, again and again, at the respective periods—or in other words, every four weeks.

3d. The bowels should be kept well regulated, by medicine of the mildest kind, as castor oil, magnesia, Seidlitz powders, &c., but purging must be avoided.

4th. She must be kept as strictly upon a milk and vegetable diet, as the condition of the stomach will permit.

5th. Sexual intercourse should be strictly prohibited.

6th. This plan must be persevered in for at least two months after the period at which the patient was usually wont to miscarry.

7th. Blisters to the abdomen or sacrum have occasionally been found useful in interrupting the aborting habit. They are, however, not only inconvenient, but sometimes very troublesome, without proving effectual; they should therefore be looked upon as a dernier resource. We recommended their use more than twenty years ago. (See Amer. Edit. of *Rees' Cyclop.* Art. Abortion.) They have since been recommended by Dr. Jackson, of Northumberland, and others. (See *Bibliography* to this article.) We have not, however, had recourse to them for some years past, for the reasons above stated, and from having found, in a great number of cases, the plan just laid down, to be attended with the most entire success.

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I. H.

ABORTION. (*Medico-legal.*) When judicial investigations are instituted in cases of real or suspected abortion, the principal points on which the medical witness will be examined, are, 1st. Has abortion really taken place? 2d. if so, was it the effect of natural causes, or was it artificially and intentionally produced?

1. *Has abortion really taken place?*—This is to be ascertained by a careful examination of the product of the premature labour, and of the female who is said to have aborted; and the chain of evidence will necessarily be defective if either of these examinations be neglected.

Examination of the embryon. To render this satisfactory, the changes that the embryon undergoes from the period of conception to the end of the ninth month, must be borne in mind. During the first weeks, the embryon being exceedingly small, may be confounded with a mole, a coagulum of blood, &c. The substances which are said to have been expelled from the womb must therefore be carefully examined, by being washed in clear water, taking care not to injure them by compression or otherwise. If they be composed of a coagulum only, this will be dissolved for the most part, leaving only the fibrine. If the expelled substance be a mole, it may be recognized by its solid consistence and other peculiar characters. (See *Mole.*) But if a fœtus be present, it will present certain signs of organization which are more or less striking, according to the age of the embryon.

Until the fifteenth day after conception, the uterus contains only the rudiments of the ovum, no part of the future embryon being distinguishable. At this period, however, MECKEL states that the ovum is six or eight lines in diameter, containing an embryon whose form has not unaptly been compared to that of a tadpole, and about three to four lines in length. At the end of the first month, the thorax and abdomen begin to appear in the form of round tubercles. At two months, the head is as large as half the body, the spine is formed, and the various parts of the face begin to be visible, whilst the extremities, although imperfectly formed, are readily distinguish-

able; and about the thirteenth week the sex may be determined. The embryon is now about two inches in length, and weighs rather more than an ounce.

After this, no mistake can or ought to be made by the most inexperienced obstetrician. At the seventh month, the infant being so fully formed as to be capable, with certain precautions, of enjoying an independent existence, any questions that may arise belong rather to infanticide (q. v.) than to abortion.

Examination of the woman. After having ascertained that the product examined was an embryon, and at what term of utero-gestation it had been expelled, the next point to be determined is the state of the mother; and the value of this examination depends in a great measure on its being made at an early period, as well as on the period of utero-gestation, at which the abortion has taken place. Actual inspection is of little use where more than a week has elapsed, as in that time the parts have so far regained their natural condition as to embarrass or even baffle inquiry. The period which has elapsed from conception has also much influence, as the derangement of the parts consequent on the expulsion of the fœtus, will, in most cases, be in a direct ratio to its age. But in every instance, if the abortion has occurred some time previous to the examination, and the woman has recovered, the fact must be proved by circumstantial evidence; and the fact of the expulsion of the embryon, can only be inferred, from pregnancy having existed. It should also be borne in mind, that the expulsion of moles, hydatids, &c., may induce the same appearance of the parts, as the passage of a fœtus through them. It is therefore evident, that no legitimate deduction can be drawn from the phenomena presented by the woman, however strong the presumption may be, without a concurrence of the following circumstances.

1. A certainty of the previous pregnancy, and comparison between the development of the fœtus and the period of utero-gestation at which the abortion was said to have taken place. 2d. Such an advanced stage of pregnancy, as to produce, with the effects of the labour, certain well-known changes in the uterus and vagina. 3. Finally, the examination having been made soon after the presumed abortion took place.

2. *Was the abortion the effect of natural causes, or was it artificially produced?* In ascertaining this, concomitant or collateral circumstances should be allowed much weight; as concealment of the pregnancy, and an application for medical aid without an acknowledgment of its existence; the purchase and use of reputed abortives, &c.: and, on the other hand, of resort to professional assistance when miscarriage was expected, and the fact of the occurrence of any event capable of producing premature labour.

As the natural causes which may induce abortion have been already fully explained, it is unnecessary to advert to them in this place. The methods employed in order to excite the expulsion of the embryon, may be referred to two general heads; those which act through the general system of the parent, and those which are applied immediately to the uterus and its appendages. To the first class belong emetics, cathartics, and emmenagogues; and to the latter, the application of leeches to the vulva, and mechanical violence.

With regard to the first class, it should be remembered, that certain drugs are generally supposed to be endowed with the power of causing the expulsion of a fœtus, and although it is now generally admitted by practitioners that there are no abortives strictly speaking, the circumstance of the purchase and administration of one or more of these articles ought to be allowed an important bearing on the case. There is no doubt, however, that emetics, purgatives, &c., are capable of producing abortion, particularly in females predisposed to it; but there is no one article, the result of whose internal administration, is abortion and nothing but abortion; the life of the mother is always endangered. There is no drug, says Dr. Male, which will produce miscarriage in women who are not predisposed to it, without acting violently on their system, and probably endangering their lives; and in this opinion he is upheld by almost every medical authority of any note.

The abortive means which act directly on the womb and its appendages or contents, are much more certain in their effects, but at the same time are more dangerous to the female. They consist in the application of mechanical irritation to the uterus and its contents, by the actual introduction of some instrument, the injection of acrid substances into the vagina, or the employment of such external violence as will irritate or injure the uterus. As respects bleeding from the foot, and the application of leeches to the vulva, though sometimes resorted to for the purpose of producing abortion, they seldom or never will cause this phenomenon, without be-

ing pushed so far as to reduce the female to a dangerous state of debility; in fact, when used moderately, they will in certain cases avert this event.

When a physician, or practitioner of midwifery, is called upon as a witness in cases of suspected abortion, his duty is to verify the fact of the abortion having taken place; and, when he has satisfied himself that this was the case, to inquire into all the circumstances which preceded, accompanied, and followed this event: thus he is to examine whether it might not have been induced by natural or accidental causes; what was the term of utero-gestation; if, from the existence of some concomitant disease, the woman had freely employed reputed abortives; and, in short, to make every inquiry that may tend to elucidate the real cause of the event. On the other hand, it is also his duty to the laws, scrupulously to weigh every circumstance which may tend to show that the abortion was premeditated on the part of the female or others. Hence, he is to ascertain whether the pregnancy was concealed, whether reputed abortive drugs were administered, whether she was solicitous to learn how abortion could be produced, &c. The fœtus and its envelopes should also be carefully examined, to discover whether they bear any marks of an instrument having been used; and in case of the death of the woman, a careful inspection of the uterus and its appendages should be made, with the same intent.

Laws in relation to abortion. The legislative enactments in the United States, respecting abortion, differ greatly from each other, whilst in some, the common law of England, as it stood at the Declaration of Independence, is still the rule of action. The English law, as stated by Blackstone, is: "If a woman is quick with child, and by a potion or otherwise killeth it in her womb, or if any one beat her, whereby the child dieth in her body, and she is delivered of a dead child, this, though not murder, was by the ancient law, homicide. But the modern law doth not look upon this offence in quite so atrocious a light, but merely as a heinous misdemeanour." This, being common law, is therefore in force in such of the United States as have no special legislative enactment on the subject. The law of England now in force under the act of 1803, being statute and not common law, has no force here.

By the revised statutes of New-York, "Every person who shall wilfully administer to any pregnant woman, any medicine, drug, substance, or thing, whatsoever; or shall use or employ any instrument or means whatever, with intent thereby to procure the miscarriage of any such woman, unless the same shall be necessary to preserve the life of such woman, or shall have been advised by two physicians to be necessary for that purpose;" shall, upon conviction, be punished by imprisonment or fine, or both.

The law in Louisiana is very full and explicit, condemning any person who procures or is privy to the procurement of abortion, to imprisonment, unless it is procured by medical advice for the purpose of saving the life of the mother. If death ensues from attempts to procure unlawful abortion, it is murder.

In Connecticut, it is imprisonment for life, or such other less term as the court may award. It is evident that where express provision to the contrary has not been made, the medical practitioner is placed in a disagreeable predicament. To save the life of the mother he is often called upon to produce abortion, and yet in all these cases he is criminal in the eye of the law, strictly speaking. At the same time, it is highly improbable that such cases will ever become the subject of judicial investigation; but still, whilst the law thus views him in the light of a felon, no obstetrician should rely on his own judgment alone, in cases thus involving the necessity of the destruction of the fœtus, and the possibility of a fatal result to the mother.

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R. E. GRIFFITH.

ABORTIVES. This term has been applied to a class of remedies which were supposed to act in a special manner on the gravid uterus, causing an expulsion of its contents. The whole of them, with the exception, perhaps, of Ergot, act by their

violent perturbating effects on the general system of the female. As, however, there exists a popular belief that certain articles are eminently endowed with the power of producing abortion, a rapid review of the action of these substances may not be uninteresting. They may be generally classed under the heads of emetics, drastic purgatives, copious bleedings, emmenagogues, and local applications.

Emetics. Although emetics, and especially those which make a permanent impression on the system, are unsafe in an advanced stage of pregnancy, they cannot be considered as possessing any peculiar action on the uterus; if abortion should follow their administration, it results from the violent shocks given to the contents of the abdomen by the efforts in vomiting, producing a detachment of the ovum.

Purgatives. The drastic purgatives act in the same secondary manner, particularly those which cause much irritation in the rectum, and thus cause tenesmus. It is this peculiar irritation, observes Dewees, which renders any cathartic that excites it, unsafe; hence, abortion frequently occurs from dysentery, whilst it rarely takes place from diarrhœa.

Copious bleedings. That these have succeeded in producing abortion there can be no doubt, but it has always been where they have been pushed to a dangerous extent. In general, instead of producing abortion, abstraction of blood will prevent its occurrence.

Emmenagogues. It is to this class of remedies that females usually resort for the purpose of causing abortion, and savin, rue, &c., have attained much celebrity for their supposed powers in inducing the expulsion of the contents of the uterus. None of them, however, act otherwise, than by their violently stimulating powers, and if abortion ensues, it is the consequence of a violent action exerted on the general system.

Local applications. These have also been used for this purpose, and there can be no doubt that abortion has thus been produced, though at the expense of the mother; the irritation and inflammation of the uterus and its appendages, which almost invariably results, and which is the real cause of the abortion, are usually fatal.

Ergot. This is the only article which appears to act in a special manner on the uterus, without at the same time causing a general perturbation of the system, and may therefore be considered as an abortive. Dr. Oslere, who experimented with it largely, is of opinion that it is capable of producing this result at any period of utero-gestation. But the use of this or any other means of producing abortion, except when directed by the experienced practitioner, will either be inefficient to effect the desired result, or will jeopard the life of the woman. *Sæpe, suos utero quæ necat, ipsa perit.*

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R. E. Griffith.

ABRASION. (From *abradere*, to scrape off.) An excoriation of the membranes, effected by the detachment of small portions of their surface. It was formerly applied, more particularly, to the superficial ulceration of the mucous membrane of the intestines. The term *abrasio intestinalis* was used by many writers to indicate the inflammation of the intestines which occasions alvine dejections mixed with membranous shreds, similar to washings of flesh. Others applied the term abrasion to the violent irritation produced by drastic purgatives. Finally, Vic D'Azyr employed it to express the absorption of the molecules of which the body is formed.

I. H.

ABSCESS. (From *abscedere*, to depart or separate.) *Abscessus*, *Abscessio*, *Apostema*, *Imposthuma*, Lat. Αποστημα, Gr. *Abcès*, *Dépôt*, *Foyer purulent*, Fr. *Die Eiterbeule*, *Geschwär Eitergeschwar*, Germ. *Abscesso*, Ital. *Imposthume*, Eng.

Used to designate all kinds of purulent collections formed in the substance of the organism. Effusions of pus into the normal cavities surrounded either by serous, synovial, or mucous membranes, are not embraced by this term. Thus, collections of pus within the bag of the peritonæum are called purulent effusions—when within the pleura they take the name of empyema. In the great natural cavities, however, there may be purulent collections which occupy a small space. They are confined by adhesions or membranous partitions. The analogy between this condition of parts, and a true abscess, is so

strong as to render it necessary to embrace both in the same description.

§ 1. **Pathological Anatomy of Abscess.**—Abscesses are usually the result of inflammation, but whether always so, or not, is a subject which has been much disputed. Suppuration is commonly preceded by every mark of active inflammation; yet many collections of matter have been found, which had not been characterized by any symptom of inflammation, or even uneasiness; nor after death could any trace of inflammation be discovered. The colour, consistence, and thickness of the textures appeared entirely unchanged. The pus seemed to be deposited in the interstices of unaltered textures. Andral supposes that persons in whom suppurations take place without previous signs of inflammation, and without an apparent adequate cause, possess what he calls a suppurative diathesis. In such constitutions, abscesses will form insidiously and simultaneously in different parts of the body; as, for example, in the brain, lungs, liver, and spleen, or on the exterior of the body, as in the legs, groin, armpit, and neck. These abscesses are not uncommon after amputation and other capital operations.

Though purulent collections are often found without any previous observable signs of inflammation, yet in a very large majority of cases, active phlogosis precedes the secretion of pus. The phenomena which precede and accompany the formation of acute abscess can be developed by this action alone. False membranes, adhesions, interstitial deposits, and pus, in most instances, are pathological productions from the same cause. The difference in the rapidity or tardiness in the formation of purulent collections, their dimensions, and the quality of the matter, are materially influenced by the particular tissue in which they may be located, and by the constitution of the patient. Abscesses have been properly classed by pathologists into acute or phlegmonous, cold, and metastatic. The character and treatment of each will be fully noticed in this article.

1. *Phlegmonous Abscess.* When any of the ordinary causes of inflammation are applied to a part, the natural preservative action becomes interrupted, and phlogosis is the consequence. Inflammation is always followed by a change of structure. This change is not confined, as has been stated, to the blood-vessels, but to all the tissues involved in this new and unnatural action, and which, if not arrested by proper remedies, results in a new and unnatural organization.

In inflammation there are no new vessels formed, but the existing ones become greatly enlarged, so that those containing formerly only a colourless fluid, now receive red blood. This engorgement of the vessels produces swelling, one of the attendant symptoms of inflammation, which varies to a greater or less degree, according to the texture of the part.

It should be remarked, however, that in inflammation of serous and mucous tissues, the turgescence arises from the number and size of the vessels; but when it occurs in the cellular texture, the tumefaction is chiefly caused by interstitial deposition. The fluid which in health is secreted into the cells, is so altered as to resemble fibrine, and being increased in quantity, renders the part larger and harder. There is, besides, partial extravasations of red blood. This has been often observed in the serous, muscular, parenchymatous, and cellular textures. In the most active inflammation, the interstitial deposits of blood are considerable in quantity, but when less active there are only particles of blood to be seen in distant spots.

These effusions of blood are not essential to inflammation. When this fluid is effused, it loses, in the progress of the disease, its colouring matter. If a phlegmon be laid open in its early and active stage, its cells are found distended with fibrine and blood. In the cells surrounding the seat of inflammation, serum and modified albumen are deposited so as to produce some degree of œdema. Besides the change which takes place in the size of the vessels, and the action of the nerves, blood, fibrine, and albumen are deposited in the interstices of the part, which alters its organization. If the patient die in this state, and the part be examined, it will be found distended in the manner already stated. The vessels are so filled with coagulated blood, that even the finest injection cannot be forced into them. If this inflammation be not removed, that is, if the deposition be not absorbed, it may end in suppuration, gangrene, or it may undergo changes of a secondary nature, and remain a parasite or new structure. A phlegmon is hard, painful, and tumefied; the parts surrounding it are slightly œdematous; the skin is florid, sometimes glossy, and tinged with yellow. Phlegmonous inflammation may exist for some time, before the skin becomes involved; when it extends to this tissue, the outer vascular layer of the derma becomes so injected as to produce superficial redness. When the inflamma-

tion is intense, there is a considerable albuminous effusion over the surface. If there be slight effusion, minute vesicles will appear, so as to cause the surface to exhibit an irregular and less florid colour. If the inflammation advance, the surface, instead of remaining hard, becomes soft and elastic, at the most prominent part, affording evidence that suppuration is established.

This process has been commonly confounded with ulceration; the two are, however, very different. The latter involves the formation of granulations in the organized matter, by which sores are healed; whilst pus is a diseased secretion. What is called healthy pus, is a fluid of a yellowish colour, of the consistence of cream, and which separates into globules, and a transparent fluid. Mucous secretions resemble pus in colour, but differ from it in containing no globules. Pus does not exhibit a homogeneous appearance; in some, it is of a cream-like appearance and consistence, and when warm, of a peculiar smell,—this is called laudable pus. In others, it is curdy, viscid, ropy or serous. These different fluids are all secreted by suppurating surfaces, but are changed by the nature of the previous inflammation, by the peculiar constitution of the individual, and by the tissue in which they are formed.

Animal matter destitute of life cannot be converted into pus, as is proved by the fact, that dead cellular membrane, tendons, fasciæ, bone, &c. may remain lifeless and unchanged for a considerable length of time. Whatever diminution of such substances may occur during the process of suppuration, is occasioned by the action of the absorbents upon the parts contiguous to the living solids.

The ancient opinion, then, that the formation of pus is the result of fermentation, has no foundation in truth. That a fermenting power has no agency in the secretion of pus may be proved by the facts, that ulcerated surfaces, and mucous membrane, furnish it abundantly, when there is often an increase, rather than a loss, of substance. The opinion that extravasated blood can be converted into pus, has been satisfactorily refuted by Hunter. I am aware that Andral has stated, that he has seen pus which had been formed in the centre of clots of blood; but this statement is so entirely at variance with the experience of others, that I am inclined to think this eminent pathologist has committed an unintentional mistake. That a clot of blood, which is destitute of vessels, could secrete pus, is an idea wholly inconsistent, not only with the experience of others, but with the admitted doctrine relative to the formation of pus. The purulent fluid always partakes of the nature of the sore which produces it. To the surface secreting it, pus is quite unirritating, though sometimes its qualities are such as to greatly irritate the neighbouring parts with which it has come in contact; hence the inutility of wiping the matter so completely off the granulations, and the propriety of keeping the surrounding skin perfectly clean.

The process by which pus is formed in abscesses, is differently explained. The most satisfactory explanation is the following. Inflammation may early abate by the diminished action of the part, and by the absorption of the interstitial deposits. In other instances, not only these deposits, but a portion of the original structure, is absorbed, and the place supplied by pus, so that the inflamed solid tumour is converted into a sac containing matter. The phlegmon, like the cellular substance in which it is located, possesses arteries which perform a twofold office—one set secretes organized particles which formed the solid structure; the other, an interstitial fluid. Both sets of arteries contribute, it is thought, to the formation of pus—the solid particles taken up by the absorbents are not replaced, as in health, by other solid particles, but by pus. A cavity is thus formed and filled by this diseased secretion.

The vessels which naturally formed the solid texture of the inflamed tumour, have their action so changed as to secrete a fluid.

While the vessels of the suppurating surface are thus secreting pus, those in the vicinity of the abscess secrete more than their ordinary quantity of interstitial fluid, which occasions a slight œdema around it.

The purulent collection approaches towards the surface more rapidly than in any other direction. Before the sides and base of the tumour have been absorbed, the covering in front is rendered very thin; the skin itself is often absorbed, and the pus discharged.

The sac of the abscess possesses remarkable properties. It secretes, absorbs, and awakens important sympathies.

The abode of an animal unorganized matter in an accidental cavity, in a sufficiently high temperature to promote decomposition, and yet no alteration occur, can be only explained by the continual renewal of this liquid. Roux thinks that the sac is capable, during the process of suppuration, of constant absorption and

exhalation. It is difficult, he admits, to demonstrate the existence and degree of activity of this double movement. It is rare that absorption and purulent exhalation preserve an equilibrium in their action. The exhalents are commonly the most active, if we judge from the promptitude with which abscesses become filled with pus after they have been punctured. This activity is increased by the removal of the pressure of the pus, from the sides of the sac. The absorbing action is, however, at times the most active, and entirely removes the pus from the sac. There are examples of this in scrofulous and venereal abscesses, but this is comparatively a rare occurrence.

The power of secretion is frequently so strong, as to cause a dilatation of the most unyielding parts. Abscesses inclosed in bony parietes, have caused a dilatation of them before a perforation has been effected by absorption, as occurs in abscesses of the frontal and maxillary sinuses. Morgagni notices the expansion of the bones of the cranium by the pressure of a chronic abscess of the brain. If there be any point in the circumference of the sac, which is less resisting than another, it will elongate itself in that direction. From this cause, added to the influence of gravity, pus will sometimes reach points quite distant from its place of secretion. We have examples of this in psoas abscess. It has long been remarked, that purulent collections tend either to the dermoid or mucous surfaces. This phenomenon attracted the attention of the celebrated John Hunter. He has offered an explanation of it, but not a satisfactory one. Perhaps the best reason which can be given is, that the parts intervening between the abscesses and these surfaces afford the least resistance. The skin is much more frequently perforated by abscesses than the mucous membrane. We see, however, that when abscesses are seated under fascia, that they tend to the internal teguments; an example of this is furnished by abscesses seated under the fascia covering the parotid gland which opens into the mouth. Abscesses of the liver frequently discharge themselves into the stomach, duodenum, or colon. Those of the right iliac fossa, as has been already said, open often into the cœcum. I have recently seen an abscess of this kind point over the posterior superior spinous process, and Roux states, that he has met with a similar abscess which opened into the bladder.

Purulent collections less frequently penetrate into serous cavities. This arises from the inflammation which precedes the movements of the matter causing a thickening of the adjacent cellular texture, if not of the serous membrane itself, and causing also adhesions between the sides or folds of this membrane, thus obliterating the serous cavity.

The process by which purulent matter is directed to the surface, is denominated, by Hunter, progressive absorption. So strong is this disposition to form spontaneous openings in particular parts, that the process cannot always be arrested by making punctures and discharging the pus at a point where the walls of the abscess are thicker. Thus abscesses at the angle of the jaw have opened into the mouth twenty-four hours after the pus has been discharged by an opening through the skin. There is no tissue of the body which offers a more prolonged resistance to the progress of pus towards the surface than the aponeuroses, or fibrous membranes; and hence, in abscesses beneath them, the sac of the abscess itself sometimes yields, and the matter extends itself along the course of the sheaths, and thus produces extensive lesions which cannot be repaired by the skill of the surgeon. When pus finds a passage through an aponeurosis, it is not by an aperture made by ulcerative absorption, but by a separation of its fibres, or it passes through the foramina, destined for the passage of the blood-vessels and nerves distributed to the skin.

The sub-aponeurotic abscess, whose contents escape through these openings to the skin, form here another collection directly over the hole through which it passed. When pus is formed under the flexor tendons of the fingers, it escapes at points corresponding with the articulations, at which place the aponeuroses are known to be thinnest.

Abscesses may be so situated, that "progressive absorption" may take place in opposite directions. This circumstance has been often observed in abscesses of the kidneys. It is more remarkable, however, when situated exterior to the pleura, as the sac has a double dilatation connected by a neck corresponding with the intercostal space.

This provision of the economy by which collections of pus which are deeply seated are conveyed to the surface, is sufficiently curious when there is a continuity of tissue. It is infinitely more so, however, when the continuity is interrupted, as in the case of suppurations which are formed in the viscera covered with serous mem-

branes. In this case the pus must traverse the two layers of serous membranes, without effusing itself into the intermediate space. An effusion of pus, under such circumstances, into a serous cavity, is a rare occurrence; but this will not be considered so remarkable, if we reflect that the serous membranes are, for the most part, everywhere in contact; and besides, nature agglutinates the opposing serous membranes before the pus of the abscess is prepared to penetrate them. The irritation which precedes the extension of the abscess, causes a secretion of coagulating lymph, which soon becomes organized, by which a living continuous union is formed between the folds of the serous membrane, which before were only contiguous. Thus, abscesses of the lungs have pointed on the outside of the chest, at the root of the neck, contrary to these laws. Dupuytren relates the case of an abscess forming exterior to the ribs, which penetrated between them and insinuated itself into the bag of the pleura. There are many instances where purulent collections have successively traversed two serous cavities, as happens when abscesses of the liver reach the bronchi.

When a collection of pus is formed originally in a serous cavity, its evacuation is sometimes, though rarely, accomplished by a process somewhat analogous to that which we have just considered. Lawrence reports a case of empyema where the pleura costalis was absorbed and the pus passed between the ribs, and was evacuated through the skin. A serous discharge continued for a long period, which satisfied this distinguished physician that it issued from a serous cavity. Andral reports a case of a similar kind.

The solution of continuity which affords an exit for the pus, is generally increased by ulcerative absorption. This is found to be especially the case when the opening has been spontaneous.

When a large abscess is evacuated, a fair opportunity is afforded to observe the sac by which it has been inclosed. It is of a whitish ash colour, resembling, in appearance, coagulable lymph. This sac so adheres, by a vascular union, to the surrounding cellular membrane, that it cannot be separated from it. Were it not for this partition between the abscess and the cells of the cellular membrane, the pus would extensively diffuse itself, as the air does in emphysema, or the water in anasarca.

The walls of the abscess now grow thinner, the interstitial deposits around it become absorbed, and vascular vegetations, called granulations, spring up from the internal face of the abscess, by which the cavity is filled up. These granulations are so contractile that the sides of the abscess are drawn together, as we observe in wounds which are healed by the process of suppuration, or as in union by the second intention.

Abscesses which have been opened do not in all situations terminate so happily. This is particularly the case in scrofulous abscesses, and those situated about the anus, or in the groin or axilla.

2. *Abscesses in particular tissues.*—Though every structure of the body is capable of inflammation, except the epidermis and its appendages, yet there are others, such as the fibrous, cartilaginous, and fibro-cartilaginous, which are incapable of forming abscesses. When pus issues from these tissues, it is from their surfaces, and not from within their parenchyma. There are some pathologists who believe that abscesses cannot be formed in the substance of serous or synovial tissues. If this be the case, it arises from the extreme tenuity of these membranes, rather than from any peculiarity of structure. I have seen, however, in thickened and diseased synovial membranes, separate minute collections of pus, which might with propriety be denominated abscesses.

Abscesses in serous cavities. Adhesions may occur between particular parts of serous membranes, so as to form a small compartment. This circumscribed cavity may become the seat of suppuration, and thus constitute an abscess. Such abscesses are formed both in the bags of the pleura and peritonæum, and also in the arachnoid membrane of the brain. Roux states that he has remarked an essential difference between the tendencies of these partial effusions in the pleura and peritonæum. While those of the peritonæum often show a disposition to point externally, those of the pleura as frequently find their way through the substance of the lungs, into the bronchi. Judging from my own experience, pus so situated rarely finds for itself an opening in any direction.

Purulent collections are found sometimes within the tunica vaginalis. I have seen pus more than once within this membrane, resulting from attempts to effect the radical cure of hydrocele.

Abscesses in the mucous cavities. There is no tissue, when inflamed, more disposed to terminate in suppuration than the mucous. But as the cavities which are lined

with these membranes have generally large natural openings, their morbid secretions are not confined, and cannot therefore readily form abscesses. There are a few circumscribed mucous cavities capable of retaining, under some circumstances, their purulent secretions. The narrow canals leading from the frontal and maxillary sinuses, the tympanum and mastoid cells, the ethmoidal cells, and the lachrymal sac, become obstructed either by flakes of lymph or albumen, or from a thickening of the mucous membrane, resulting from previous inflammation.

Abscess in articular cavities, and in the sheaths of tendons. I have seen, as already stated, in synovial membranes much thickened by slow inflammation, small collections of pus within their substance, which might be denominated abscesses. As diseases of joints, however, will be particularly noticed under the word *Articulation*, I will refer for further remarks on this subject, to that article. Effusions of pus within the bag of the synovial membrane of the joint, will not, of course, be considered under the term abscess.

When suppurations occur within the synovial membrane of tendons, they are painful, but not attended with the same unhappy results as when situated within the joints. The former may with propriety be recognized and treated as an abscess.

Abscesses in the medullary cavities of the long bones. It is stated by authors that pus has formed within the medullary cavities of bones, and that it has been evacuated by the application of the trephine. Such suppurations, however, I have never witnessed, except in connexion with necrosis. Hennen mentions several cases of suppuration in the cavities of bones which had been amputated. It has also been remarked that the periosteum is detached as far as the internal suppuration extends.

Abscesses in the interior of vessels. Inflammation of arteries seldom, if ever, terminates in suppuration; but their sides are strongly disposed to form adhesions, and thus become obliterated. This is not the case, however, with veins. Their sides adhere at points, and form suppurations or abscesses within them. The inflammation most readily extends to the adjacent cellular tissues, which also become the seat of abscesses. I have repeatedly seen abscesses over an inflamed vein of the arm, where there was no reason to believe that any had formed within the vessel itself, and a similar phenomenon has been observed to follow inflammation of the lymphatic vessels.

Abscesses of the skin. Most of the exanthemata terminate in pustules which may be considered the abscesses of this tissue. Furuncular inflammations usually commence in the skin, and therefore the suppuration which follows them may with propriety come under the same class.

Abscesses of the cellular tissue. Abscesses are more frequently seated in this tissue than in any other; and they exhibit in it every variety of character. They may be acute or chronic—painful, or not at all so, according to the constitution of the individual affected, or to the particular circumstances under which he may be placed. They may be located in the cellular structure under the skin, under the fascia, under the muscles, under the bones, as when seated in the mediastinum, or under the scapula. It has been remarked by Hunter, however, that the deep-seated cellular membrane is less disposed to inflame and suppurate than that which is superficial. This difference may in part arise from the internal layers of this membrane being less exposed to injury and to the causes which produce inflammation, than such as are more external. This cannot, however, be the entire cause; for we often see a foreign substance traverse a considerable extent of the body, through the cellular texture intervening between the muscles, without producing the slightest irritation; but so soon as it reaches a point near the surface, inflammation supervenes, which terminates in abscess, by which the offending substance is expelled. This accident furnishes another evidence of the wisdom by which the movements of our economy are conducted, or of the force of the preservative principle which guards us against the evils by which the system is continually assailed.

Abscess of the lymphatic glands. The deep-seated and superficial glands are liable to inflammation, which not unfrequently terminates in abscesses. When these form internally, they commonly assume the character of tuberculous suppurations. When they occur near the surface, as in the neck, armpit, and groin, they frequently result from the distant irritation of an absorbent leading to the diseased gland. Inflammation of the foot, or penis, or the irritation of a corn, will often produce abscess in the groin; and I have seen one in this situation produced by rubbing on the side, ointment containing tartarized antimony, thus irri-

tating the absorbents which run from the flank to the groin. Abscesses will form also in the axilla, from irritation of the hand or arm, as in wounds received in dissection, &c.

When suppuration takes place in this tissue, it is not commonly confined to one central cavity, but begins in different neighbouring cells. These are at first filled with lymph, then with a bloody serum, and afterwards with pus. The cysts which divide the cavities sometimes continue separate after suppuration is fully formed, but more frequently they become all embraced in one. These abscesses often burst before the whole substance of the gland has been converted into a cyst. The skin does not usually participate in the inflammation until suppuration has considerably advanced. During the stage of inflammation preceding the formation of the abscess, there is generally but little pain, except when the gland is situated under a fascia.

Suppurations along the track of inflamed absorbents not unfrequently occur. These suppurations are, however, seated in the cellular structure adjacent to the lymphatics, and not in the vessels themselves.

Abscesses in the muscles. It is denied by many pathologists that abscesses can form within the substance of a muscle, but it is admitted that they are often seated in the cellular structure around and between them. Whether the absorbents can take up a portion of the fibres or the belly of a muscle, and thus afford an opportunity for the deposit of pus in its place, is a matter which is certainly in some degree doubtful. I have seen abscesses separate muscles throughout their whole extent, and though they exhibited a pale and flabby appearance, there did not appear any loss of substance. Whilst these muscles readily become violently inflamed, as in rheumatism, its termination in abscess is, to say the least, a rare occurrence. I have never seen a muscle in a state of suppuration, except where there had been a solution of continuity, as in gun-shot injuries, compound fractures, &c., and then it would not deserve the name of an abscess. That abscesses will form, however, in the substance of muscles, we are bound to believe, because we have positive testimony on this point from authoritative writers.

Abscesses of the nervous tissue. ANDRAL remarks that it is a question which yet remains to be decided, whether, when the nervous tissue is in a state of suppuration, the pus is furnished by this tissue itself, or by the cellular texture which enters into its composition. It is certain, however, that in abscesses of the brain, we find little else in the seat of the suppuration, than cellular tissue, the nervous matter having entirely disappeared. Is it not fair to infer, then, that the former is the seat of suppuration? The white softening of the brain has been regarded as the effect of purulent infiltration. This opinion, in the estimation of ANDRAL, is a mere gratuitous hypothesis. There is no evidence of the existence of pus in these cases of softening; there is a mere alteration in the consistence of the nervous tissue, caused, no doubt, by previous inflammation.

Abscesses of organs. These are usually divided into secreting, parenchymatous, and hollow organs. The latter are lined by a mucous membrane, and abscesses sometimes form between their laminæ. As they are seated in the cellular tissue between these membranes, they should be called abscesses of this tissue, rather than of the organs themselves. These abscesses usually discharge into the hollow viscus, leaving an ulcer extending through the mucous membrane, and in a few rare cases they have pointed and burst externally. It is stated on the authority of ROUX and BEBARD, that an abscess located between the membranes of the stomach, which had previously formed adhesions to the side of the abdomen, opened through its parietes, and finally terminated in a fistulous opening into the stomach. (See *Stomach, fistulæ of.*)

Pus is sometimes formed between the laminæ of the uterus, after inflammation of this organ. It is said by TWEEDIE that in this condition of the womb, the uterine and hypogastric veins often contain pus. This is the result, doubtless, of uterine phlebitis. Purulent collections have been also found within the cavity of the uterus and fallopian tubes. It is stated by Dr. CARSWELL that a large body of pus was confined in the uterus by a false membrane which had completely obstructed its neck. (*Cyclop. Pract. Med.* I. 19.)

Abscesses of the Brain. This organ is not unfrequently the seat of purulent deposits. The sero-purulent effusion generally precedes, however, the formation of abscess. It is stated by ANDRAL that the first step in the suppurating stage is the formation of numerous small drops of pus, through a greater or less extent of the nervous substance, which is at the same time injected and softened. These drops multiply and run into each other.

The substance of the brain contiguous to the drops, grows gradually softer, until it appears, with the exception of a few filaments, dissolved in the pus. The purulent cavity is not perfectly circumscribed until the abscess is in an advanced stage.

It is remarked by ANDRAL, that "when the parietes of this cavity first become distinctly marked, they consist merely of the nervous substance itself; but subsequently we observe on their surface, in succession, 1st, a cellulo-vascular substance, either spread uniformly over their whole extent, or existing only in some isolated points; 2d, a real membrane, which, however, is still soft, flocculent, and separable from the nervous substance; 3d, a membrane of more firm consistence, and distinct organization, which is sufficiently tenacious to be detached either in shreds or in a single piece from the subjacent tissue. When this membrane is thus far developed, it may assume various appearances; being, in some cases, found to consist of several folds, each of which seems to constitute a distinct membrane; and, in others, having its internal surface covered with filaments which float loosely in water, like villi" (*Path. Anat.* II. 770.)

The brain in the vicinity of an abscess does not always present the same appearance. While, in recent cases, it is unusually vascular and soft, it is often in a natural condition in abscess of long standing, where the pus was perfectly encysted. Under such circumstances it has been discovered that an abscess, of some magnitude, may exist in the brain, without giving rise to any alarming symptoms. This morbid condition was only detected after death. (LALLEMAND and ANDRAL.)

2. *Chronic or Cold Abscess.*—This species of abscess is divided by some authors into idiopathic and symptomatic. The latter has been sometimes denominated abscess by congestion—it occurs in constitutions of scrofulous taint, and frequently presents itself at a point distant from the seat of its formation. The psoas abscess furnishes an example of this kind.

Cold idopathic abscesses are usually developed either in the subcutaneous cellular tissue, or in the lymphatic glands. They are usually located either at some point on the exterior of the thorax, the neck, the loins, the circumference of the pelvis, or the extremities. Their causes are imperfectly known. They are admitted sometimes, however, to result from contusions, and from unequal pressure. Encysted tumours, to which cold abscesses have many points of resemblance, arise in a majority of instances from these causes. The period between the infliction of the injury and the appearance of the tumour, is in both instances frequently quite distant.

The formation of cold abscesses is doubtless preceded by a slow inflammation, but often so inconsiderable as not to be perceived either by the surgeon or patient. They are characterized neither by pain, redness, nor heat; nor does any other inconvenience result from their presence, except the restraint which their pressure may exercise on neighbouring organs. The opinion of DE HAEN seems not incorrect, that the arteries take on the office, at once, of secreting pus. In other instances, an induration and tumefaction of the subcutaneous cellular tissue may exist for a long period before the secretion of pus. After matter has been fully formed, it may remain stationary for months. There is no indication of the approach of that ulcerative process which has the effect of procuring an evacuation of the abscess.

The first evidence we frequently have of the existence of this disease, is the appearance of a soft, fluctuating, non-pulsatile, indolent, subcutaneous tumour. There is no change of colour in the superincumbent skin, unless it is so distended by the volume of pus beneath, as to cause consecutive inflammation. These, unlike phlegmonous abscesses, show no disposition to point.

The parts concerned in cold abscesses have been found on examination to exhibit the following appearance. The pus is contained within a distinct cyst, the external surface of which is continuous with the surrounding cellular tissue. The internal surface is spongy, and bears some resemblance to mucous membrane. There are small blood-vessels, filaments of nerves, and cellular texture, which cross and divide the cavity of the abscess. The sac containing the pus is a newly-formed organ which performs the office of secreting an abnormal fluid. The pus is serous and flocculent, like the contents of most other chronic abscesses. The caseous flakes are sometimes so large that they cannot escape through a puncture of an ordinary size.

In some instances the constitution is not apparently disturbed by the formation of these abscesses. I have seen them as independent of the general system, and apparently having as little sympathy with it, as an encysted tumour of the meliceres class. Such is the case in a patient now in the Pennsylvania Hospital. She had a cold abscess on the outside of the leg, below the

knee, of two years standing, from which she suffered neither the slightest local uneasiness nor constitutional disturbance. It was discharged by a valvular puncture, as recommended by Abernethy. In two days the pus again accumulated; and though the abscess was again evacuated, it became painful, alarming constitutional symptoms supervened, such as fever, dry tongue, and other evidences of gastric irritation. These symptoms, I believe, very commonly follow the opening of such abscesses. Hence their treatment must be very different from that of a phlegmonous abscess.

The symptomatic abscess, or abscess by congestion, or abscess by depot, (for it is known by all of these terms,) forms suddenly, and is symptomatic of a distant local affection. It is truly a cold abscess, as there is not the slightest inflammation at the point where the pus accumulates, because it issues from a distant source. It is usually the result of caries of the vertebræ. It may present at the groin, by the side of the anus, the loins, or at the neck. The pus may travel through the cellular texture in a direct or in a tortuous course, so as to reach the points already indicated. We see abscesses in the inferior part of the thigh which communicate with the hip-joint, as in coxalgia; also near the elbow, the pus of which issues from a diseased shoulder-joint. I do not deem it necessary to dwell longer at this time on abscesses of this character, as they will be noticed when those of particular regions are described. Entertaining the opinion already stated, that cold abscesses are a kind of encysted tumour, I believe the most successful method of treatment would be, to extirpate them, provided they are so situated that this operation could be accomplished. By this method, the surgeon would only have to contend with an incised wound made in healthy tissues, instead of an extensive and irritable diseased surface, which awakens often the most alarming constitutional disturbance. Though the patient may have been entirely free from every kind of unpleasant symptom, either general or local, before the abscess is opened, yet afterwards, notwithstanding every precaution, he experiences much pain in the diseased part, much symptomatic fever, generally of the hectic kind, gastric distress, diarrhœa, and other symptoms of an alarming nature.

3. *Metastatic Abscesses*, are such as suddenly form without previous signs of inflammation, and in a part of the body distant from the point where suppuration had actually existed. On this account the ancients were of opinion that they were the product of metastasis, or that the purulent collection had changed its place. This opinion is entertained by many modern physicians.

The nature of these abscesses may be better understood, perhaps, by examining the circumstances and condition of the economy at the period they usually form. They are known to occur after amputations, fractures, extensive wounds, great surgical operations, and in the female after delivery. It is believed, indeed, by one of the authors of the *Dict. de Médecine*, that metastatic abscess may be the result of every lesion in which veins of any magnitude are interested. This writer, Dance, is of opinion that they are commonly the result of phlebitis, whether arising spontaneously or from wounds. During the formation of these abscesses, the patient is affected with severe and repeated rigors, resembling a paroxysm of intermittent fever, and sometimes with delirium, stupor, and prostration. Commonly they succeed the original lesion on the tenth or twelfth day, and often when the general and local symptoms are most favourable.

Metastatic abscesses are usually seated in the viscera. The lungs and liver are the most frequently affected, then the spleen, and lastly the brain, heart, and kidneys. They are sometimes, though much less frequently, seated near the surface of the body, as in the cellular texture and around the joints. They form in those viscera which are largest, and most abundantly supplied with sanguineous vessels. Where the organs are double, the abscess selects the largest; hence the right lung is more frequently affected than the left. Dance states, that if the organ is unequally vascular, it selects that part which has the greatest number of vessels. For this reason these abscesses prefer the circumference of the liver to the centre, the cineritious part of the brain to the white. They are sometimes seated within the membranes around these viscera, as in the bag of the pleura, the peritonæum, and in the arachnoid membrane.

There are frequently a number of metastatic abscesses in the same individual. Dance has seen as many as a thousand scattered on the surface of the deep-seated organs. They are generally found most abundantly in the lungs, liver, and brain. (*Dict. de Méd.* 2d Ed.)

These small purulent points are lodged in the substance of these organs. Around them the structure appears in no way al

tered. From this circumstance it is inferred, that these abscesses are the product of metastasis. DANCE (*O. C.*) states, however, that careful dissections have demonstrated that the coats of the vessels converging toward these purulent points, are inflamed and thickened, and are filled with pus and coagula of blood. The *large* veins of the lungs frequently participate in this inflammation. CRUVEILHIER is of opinion that there is a capillary phlebitis in all abscesses. This declaration has been attempted to be sustained by demonstrations, but they are by no means satisfactory.

Metastatic abscess, according to DANCE, commences in the form of a kernel, softened in the centre, and this softening gradually increases to the circumference. The matter exhibits a reddish cast, resembling an admixture of blood and pus. In a short time the purulent matter acquires the consistence and colour which result from local inflammation. These appearances in the metastatic abscess are modified by the structure in which it occurs.

When it forms in the lungs, exhibiting at first the appearance of a hard circumscribed kernel, it is frequently confounded with tuberculous abscess, and there would be some difficulty, perhaps, in pointing out the anatomical distinction between the one and the other. This, however, has been attempted by DANCE, who states that the metastatic abscess commences in the base of the lungs, and the tuberculous near the summit, and that the former is smaller in volume, and is besides the result of a lesion in a distant part of the body.

Metastatic abscesses of the *liver* have long since attracted the attention of surgeons. They frequently follow injuries of the head. Though superficially situated, so far as regards this organ, they are not so much so as those of the lungs. It has been observed, however, that when abscesses of this character occur in the liver, they are surrounded by some degree of inflammation, which extends to its peritonæal covering. DANCE states that they are less round and circumscribed than when seated in the lungs, and rather resemble irregular masses than tubercles. They frequently follow operations about the anus, comminuted fractures of the lower extremities, and injuries of the head.

When these abscesses occur in the *spleen*, the purulent collection consists of an admixture of pus and blood, resembling a dissolution of the organ. I have never seen this abscess myself, but its contents are represented by DANCE to be of a reddish, brownish, or blackish appearance, with a whitish tint, which affords evidence of the existence of pus. The difference between the appearance of metastatic abscess of the spleen and that of the lungs and liver, results from the peculiar structure of these organs. The purulent collections in the spleen are less common and are fewer in number, but of larger size, than in the other organs.

Metastatic abscesses of the *brain* do not exhibit, in the first instance, the kernel form which has been observed in those of the lungs and liver, but appear in purulent drops which are extensively scattered throughout the brain. They are chiefly seated in the cineritious or most vascular part of this organ; but are found also in the gray substance of the thalami optici, and corpora striata. The cerebellum is likewise affected with these abscesses, but to a less considerable extent than the cerebrum. Morbid anatomy has not yet taught us whether or not the spinal marrow has participated in this affection. DANCE reports four examples of metastatic abscess of the brain, all of which succeeded to lesions of the lower extremities, and to the inferior part of the trunk. He adds, that it is a singular fact, that lesions of the inferior part of the body give rise to metastatic abscesses in the superior, and vice versa. For example, wounds of the head produce abscesses in the liver, and wounds of the inferior extremities and lower part of the trunk cause abscesses in the brain.

Metastatic abscesses of the *heart* and *kidneys* are of more rare occurrence. As in the brain, abscesses of the former organ are small, often mere purulent drops deposited between the fleshy columns. In some instances they are very numerous, and may be formed either within the substance of the walls of the auricles, or ventricles, or in the columnæ carneæ. There is nothing sufficiently peculiar in the metastatic abscesses of the kidneys to require a particular description. They are generally located in the cortical substance of this organ, and occur more frequently in the right kidney than in the left.

Metastatic abscess of the *exterior of the body* is found in the superficial cellular tissue, in the muscles, and around and within the joints, the larger of which last are most subject to this form of abscess. In some cases several articulations are in succession affected in the same subject. Like other abscesses, these give rise to disorganization; the cartilages, ligaments, and synovial membranes, becoming ulcerated. They may first form within the

joint, and afterwards around it without any communication being established between the two. They not unfrequently exist, at the same time, in the viscera. These abscesses sometimes follow delivery, serious lesions of the extremities, the operation of blood-letting, and violent eruptive diseases, particularly confluent small-pox. As has been already stated, they form at a distance from the point of lesion. When one leg is injured, the abscess forms in the opposite one. There is a patient in the Pennsylvania Hospital, affected with two abscesses in the left leg, occurring without pain or apparent inflammation, arising from a compound fracture of the right leg.

These abscesses are sometimes numerous, and form in various parts of the body. Dance observed as many as ten in one case, and each of them remarkable for the quantity of pus which it contained. He adds, that during the formation of these abscesses, the cellular texture preserves its natural character, and presents a blackish circle, as it does when they form in the pulmonary tissue; but if the neighbouring veins be examined, they will be found thickened, red, obstructed by sanguineous concretions, and soon afterwards the cellular tissue becomes involved in inflammation.

When these abscesses form in the muscles, they seldom acquire a large size. By discharging the purulent matter, the cavity seems to embrace the whole thickness of the muscle, which appears, indeed, as if it had been dissolved in the pus. The muscles of the extremities are more frequently the seat of these abscesses than the trunk, and those of the calves of the legs are more common than any others. In metastatic abscesses of the muscles, the veins in their vicinity are not so much inflamed as when they occur in the cellular texture.

Metastatic abscesses in all situations preserve a great similarity of character, not only in their symptoms, but in their anatomical arrangement. They always form with astonishing rapidity, and without either pain, heat, or redness in the part which they have selected for their seat. The first evidence of their existence is the appearance of a fluctuating tumour. This absence of the phenomena of inflammation is common to both deep-seated and superficial metastatic abscess. When they occur in the spleen, kidneys, or heart, there are no symptoms which indicate their formation. Preceding their appearance, there is, it is true, great constitutional disturbance, indicated by a hot skin, rapid pulse, occasional delirium, and disordered stomach; but as these symptoms attend other lesions, they cannot be considered as indicating the approach of metastatic abscess.

The insidious manner in which these abscesses are developed in the liver, after wounds of the head, has been a common remark among surgeons. It is sometimes connected with jaundice; but this complication is not of frequent occurrence. A yellow tinge of the skin is, I believe, a constant symptom of the metastatic abscesses in all regions; but this appearance cannot be readily confounded with jaundice. Occasional pain in the right hypochondrium, and bilious vomitings, are also symptoms attending their formation.

In metastatic abscesses of the lungs, the *diagnostics* are unsatisfactory. As in pneumonia, the respiration is frequent and constrained, and it has been remarked by Reynaud, that the breath is fetid, exhaling the odour of pus, attended with dry cough. He remarks also, that in such cases little reliance is to be placed in percussion and auscultation. The smallness of the abscesses in the pulmonary tissue, leaves the great body of this organ in such a state as will freely admit of dilatation, so that the thoracic sound and respiratory murmur are not materially altered. Dance asserts that the chief reason of this disease not being detected by auscultation, arises from the minute abscesses being located in the small pulmonary veins, rather than in the air-cells. He supposes that they are in consequence out of the direct channel of respiration, and cannot therefore materially influence the natural rhonchus. It must be therefore admitted that the diagnostics of interior metastatic abscess are involved in great uncertainty.

When these abscesses are developed near the surface of the body, they are detected by their fluctuation. They are more frequently located in the cellular tissue of the calf of the leg and thigh than in any other part.

With regard to the particular *treatment* of metastatic abscess, I have little to offer that is satisfactory, and shall therefore be brief. The suddenness with which these abscesses form, the want of premonition of their approach, and the lesions which they often occasion in vital organs, render them, in a majority of instances, entirely unmanageable. Admit that the pathological views of Dance are correct,—admit that he has proved by autopsic examinations that these abscesses are the result of phlebitis; still, their insidious and stealthy approach renders it impossible that the

surgeon can apply his remedies until the economy is prostrated by their desolating influence. I have never known metastatic abscesses developed in the interior, which did not prove fatal. When they occur near the exterior of the body, they must be discharged by an early puncture; pressure is required to bring the sides of the abscess in contact, and such medicine and diet prescribed, as the existing general symptoms seem to demand. I prescribed, in one case of external metastatic abscess, with marked advantage, the ioduret of iron, in doses of ten drops, twice a day. It arrested wasting perspirations, excited an appetite, restored the process of nutrition, filled the abscesses with healthy granulations, and the patient perfectly recovered. The abscesses in this case were located in the thigh, and were caused by the irritation of a compound fracture in the opposite extremity.

Brisk emetics and cathartics have been recommended in such cases. Purulent and fetid discharges have been observed during their operation. Dance administered an emetic during the first chill which accompanied the formation of a metastatic abscess, which had the effect of retarding the march of the disease. These remedies cannot be profitably repeated. Our chief reliance should be placed, in exterior metastatic abscess, on making an early opening, and on the judicious application of bandages, so as to obliterate its cavity. The only class of medicines which seem to promise success are alteratives, such as the various diet-drinks, the different preparations of iodine, and minute doses of calomel, not carried to the extent of salivation. The diet should be nutritious, but not stimulating.

§ 2. Treatment of Abscesses.—It has been already stated that abscesses are sometimes dispersed by the absorption of their contents. This is an event, however, which so rarely occurs, that it is questionable whether we should be influenced by it, in our management of them. Abscesses seated in the lymphatic ganglions are more frequently absorbed than those situated in the cellular texture. When they appear in persons reduced by previous disease, the absorbents are sometimes in such a state of activity, as to cause the pus to be absorbed, particularly if a proper impression be made at the same time on the kidneys, bowels, and skin. Chronic abscess is sometimes dispersed by absorption. When evacuants have been ineffectually tried to promote the absorption of pus, a trial of local excitants may be made; such as iodine, the sulphurous *douches*, frictions with camphorated and terebinthinated liniments. In case of chronic abscess, blisters have been advantageously used.

Mr. Abernethy had great reliance on the aid derived from the absorbents, in the treatment of lumbar abscess. After repeatedly puncturing, and thus reducing them to a diminished size, he endeavoured to produce the removal of the remaining pus by exciting the action of the absorbents, by the use of emetics, purgatives, electricity, frictions, &c. Some surgeons have great reliance on the efficacy of lunar caustic in promoting the absorption of abscesses, and particularly those of the fingers, denominated whitlow. (*q. v.*)

Abscesses, of the phlegmonous kind particularly, often open spontaneously. When this happens, their exterior boundary becomes gradually thinned by the process of absorption, until an opening is effected and the pus discharged. Superficial acute abscesses usually pursue this course, and afterwards heal with great readiness. In general, however, it is most advisable to open them artificially. It shortens the duration of pain, and prevents the formation of sinuses.

Imperfectly formed abscesses, with hardened base, should not be opened. The hardness has disappeared most rapidly when left to the operations of nature. We have it often in our power to accelerate the process of suppuration, and lessen the constitutional effects when these are severe; though not to the extent which has been supposed. It should be recollected that the existence of pus does not necessarily change the nature of the action which produced it. On this account, local antiphlogistic remedies should not be always relinquished after suppuration has commenced. So long as pain, heat, redness, and tension, continue around the abscess, leeches and other modes of capillary depletion should be used. Moist heat, applied in various ways, is the agent on which we chiefly rely to promote suppuration. If applied prematurely, or the heat be too great, it gives pain, and proves injurious. On the contrary, if the process advances slowly, heat may accelerate the purulent formation. In the first case it is injurious, in the second, useful. Where the suppurative process is going on with sufficient activity, it may be doubted whether heat can accelerate the action. A high degree of it would prove detrimental under such circumstances, while

tepid applications might hasten the maturation, and keep the parts easier than if nothing were applied. Thus used, while it does not interfere with the suppurative process, it allays irritation, and prevents the renewal of inflammation. It is most commonly employed in the form of bread and milk poultice, or poultices of ground flaxseed, or of Indian meal. (See *Poultices.*) These poultices should be of a sufficient size to cover the inflamed part, and changed as often as they become dry. They soon acquire the temperature of the part on which they rest, and therefore only require to be changed when they lose their moisture. With the view of preventing evaporation from the poultice, which is the cause of the dryness, it is advisable, in cases where it might be inconvenient to make frequent changes, to spread the poultice on soft oilcloth. Thus applied, it will remain moist for twenty-four hours.

The time required for an acute abscess to open spontaneously varies according to its situation and extent. When seated in the superficial cellular substances, it may burst within a week; but when more extensive and deeper seated, it requires thrice this period, or even a longer time.

It is a rule with some surgeons to allow acute abscesses seated superficially, to burst, while they deem it always necessary to open those which are under fascia, or where their continuance might prove in any degree dangerous. Even the first class, however, may be often advantageously opened by artificial means. It should be done as soon as the presence of matter is indicated by a fluctuation. There are many cases, indeed, which imperiously demand an early opening, and which shall be briefly stated. These are abscesses about the perinæum and anus, complicated with an extravasation of urine or feces. Abscesses which form around the rectum, sides of the neck, groin, the arm-pits, and the ham, if not early opened, will spread, form sinuses, and thus produce extensive mischief.

Chronic abscesses require to be opened, because the absorption of the superincumbent parts is so slow, that a spontaneous opening may not take place for months. In the mean time the pus will be accumulating and the cyst enlarging, by which the disease, from its extent, is gradually becoming more dangerous.

Abscesses seated under thick fascia or between muscles, require, as I have already stated, an early opening. Experience and tact are demanded to detect pus thus located. A slight inflammation, or tumefaction of the parts beneath the fascia, will render it very tense and give it a feeling of fluctuation. By accurate examination, however, the surgeon will discover that the parts possess elasticity rather than fluctuation. If pus were under the fascia, pressure at one point would produce a discernible projection at a distant part; or an impulse given at one spot will produce a feeling of fluctuation at another. When the pus is quite deeply located, the application of considerable force is required to render the fluctuation apparent. The fingers or thumbs should be placed over the suspected purulent collection; and while firm and continued pressure is made with one hand, a gentle rising will be observed under the other, which is stationary. In this way accumulations of pus have been detected which had long eluded the attention of more superficial examiners. If the matter be not promptly discharged when thus located, it will diffuse itself extensively wherever the looseness of the cellular tissue will permit, so as to separate the muscles from each other. The absorbents have not the power to make a speedy opening through the fascia itself. The confinement of the matter has sometimes produced sloughing of the tendons, and when mutilations have not resulted, the limb has been much enfeebled and the recovery slow.

Abscesses under the palmar and plantar fasciæ, and within the sheaths of tendons, require the same treatment. Sloughing of the tendons is a frequent consequence of accumulations of pus within their sheaths, as in whitlow. This disease is not, it is true, always so deeply seated. It may be located in the true skin, in the cellular tissue beneath it, within the thecæ, or in the bone itself. Let the seat be where it may, however, a free and early opening lessens pain, and arrests the destructive progress of the disease.

Abscesses situated in the natural cavities of bones, as in the antrum, frontal sinus, &c., require an early opening; as do those which are so situated as to be liable to burst into the chest, abdomen, or into the capsules of joints. The latter accidents, however, rarely happen, the pressure of matter on serous and fibrous tissue rather thickening than weakening them. There are instances, however, of abscesses bursting into the bag of the pleura, and loss of life has been the consequence. It is stated by Samuel Cooper, that abscesses formed under the deep fascia of the neck have descended into the chest along the course of the great blood-vessels. In all highly

vascular and nervous parts, no time should be lost in discharging the purulent collection. Suppuration of the globe of the eye may be taken as an example of this kind.

In conclusion, it may be stated as an undeviating rule, that abscesses should be early discharged, if so situated as to produce dangerous consequences by pressing on some important part. As examples, it may be stated that abscesses on the urethra may produce suppression of urine; on the parotid gland may interrupt the free return of blood from the head to the heart; in the tonsils, on the trachea, pharynx, or œsophagus, would seriously impede the functions of respiration and deglutition. Bones are, however, very rarely injured by the external pressure of an abscess. When caries or necrosis takes place, it is rather the cause than the consequence of abscess. In case of purulent collections over the spine, the bony structure is generally the original seat of the disease. Cells are formed in the bodies of the vertebræ by the absorption of the earthy matter in which pus is secreted, which afterwards finds its way into the adjacent cellular texture.

There are three methods of *opening abscesses.* 1st. By a lancet or bistoury: 2d. by caustic: 3d. by a seton. The first is generally to be preferred. It is accomplished the most speedily, affords the least pain, does not occasion loss of substance, and the cicatrix is smaller than after the other methods. The opening may be made with a common bleeding lancet, with an abscess lancet, or with, what I prefer, a very narrow and curved bistoury. The latter instrument enters with less pain, and as it is drawn out, the incision may be enlarged to any extent which may be deemed necessary.

The situation in which the puncture should be made, is where the external boundary of the abscess appears to be thinnest, or where it is inclined to *point.* This should not be, however, an invariable rule. If the pointing presents at the upper boundary of the abscess, the pus would have a difficulty in escaping, and, as it is secreted, would fall to the lowest part of the sac, and thus prevent its contraction. On this account, then, the most depending part of the abscess should be selected for the incision. If an opening be made in the superior part of the abscess, either by the process of absorption, or with the lancet, a counter-opening is generally required at the most depending part, so as to afford a ready exit to the matter as fast as it is secreted. The size of the opening must depend on the form of the abscess, and on the quality of the matter. When the pus is curdy, as in scrofulous abscess, a larger opening is necessarily required. It is proper to prevent the incisions from uniting by the first intention, by interposing a piece of lint, or charpie, between the lips of the wound.

When large abscesses rapidly form, their contents frequently burrow passages in the adjoining cellular texture, forming prolongations which are denominated *sinuses.* These differ from fistulæ, inasmuch as the former have no external opening. Sinuses form in consequence of the secretion of the pus being rapid, and of the unyielding nature of the superincumbent fascia. To prevent their formation, an early opening must be made. In chronic cases, it is often necessary to lay them open, or to inject them with stimulating fluids, and to apply pressure. The same treatment is generally required in case of fistulæ.

After an abscess is opened, it should not be rudely and painfully squeezed, as is sometimes practised; since after suppuration some degree of inflammation still remains; and it must be, therefore, apparent, that squeezing and kneading a part thus extremely sensible from inflammation, must inflict present pain, and excite additional inflammation in the sac. The subsequent secretions of pus are consequently less healthy, and symptomatic fever is not unfrequently established.

If the opening be made sufficiently large, the matter will freely escape without the assistance of pressure. Where there are flakes of coagulable lymph in the purulent collection, pressure may be found necessary to cause their discharge. Matter may be evacuated without inflicting pain by the application of a succession of cupping-glasses over the puncture. In the scrofulous or cold abscess, I have used the cupping-glass with the exhausting pump, with evident advantage.

Having formed an opening in the abscess, the emollient poultice should be re-applied; and continued as long as any hardness or inflammation may exist around it. Afterwards, or when the surrounding parts are reduced to their natural aspect and temperature, or when the abscess becomes chronic, the poultice should be abandoned, and simple dressings, with pressure by means of a roller, substituted. In case it is located in the groin, pressure may be very successfully made by means of a truss.

Pressure forces the opposite sides of the cyst in contact—prevents the lodgment of pus—excites the adhesive inflammation, and thus obliterates the purulent cavity.

When it is deemed advisable to open an abscess by means of caustic, a piece of adhesive plaster is placed over it, in which has been previously made an oval opening corresponding in size with that which it is thought advisable to make through the skin. Caustic potash, either alone, or combined with an equal quantity of quick-lime, is now rubbed through the oval space, until the skin assumes a brown appearance. The potassa and quick-lime may remain on fifteen or twenty minutes, when it should be wiped off, and the adhesive plaster removed. An emollient poultice should now be applied, and continued until the deadened part sloughs away. Sometimes the parts are not destroyed to a sufficient depth to reach the pus, and the surgeon is compelled afterwards to use the lancet.

This method is never advisable in acute abscesses, except where the patient is so timid as to prohibit the use of cutting instruments. Even in this case, we may generally wait for a spontaneous rupture. To open cold abscesses, caustic is often advantageously used. It excites, it is thought, a healthy inflammation in the sac, alters its secretions, and strongly disposes it to take on the restorative process. When, however, the abscess is of great extent, it is preferable to evacuate the pus by repeated punctures, according to the method practised by Abernethy. By this treatment its dimensions progressively diminish. When it is thus reduced, the caustic may be used with the best effects. It may be also used advantageously to destroy the diseased skin which is often connected with various forms of abscess. The method of opening abscesses by caustic has some objections. The eschar which it makes, is slow in separating; it produces loss of substance, and, consequently, more or less disfigurement.

Setons have been used for the purpose of opening abscesses. The advantage which surgeons promise themselves from their employment, is, that whilst the seton will admit the slow and gradual evacuation of the pus, it will oppose the entrance of air into the purulent tumour. The practice is now very deservedly rejected. In an abscess preceded by active inflammation, the introduction of the seton will often produce much local irritation and symptomatic fever. When used in cold abscess, it is found to possess no advantage over simple incision: whilst it occasions considerable pain, there is found much more difficulty in keeping the part clean, and the period of restoration is in no degree abridged.

The manner of introducing the seton in such cases, is, to make a small puncture with a bistoury, at the superior side of the abscess, and then to introduce a long straight needle, armed with a skein of silk, or a piece of tape, which is made to traverse the tumour, and is brought out at the most depending part.

Whatever may be the method selected to open the abscess, the consecutive treatment is the same. The dressings have the double object of favouring the escape of the pus, and of approximating the sides of the cavity which contains it. With this view, the opening of the abscess must be kept constantly free. If the lips of the incision are disposed to heal too rapidly, it is necessary to interpose a pledget of lint, or a strip of fine linen, which should not be so large as to fill up the opening, and thus prevent the escape of the pus. If, from any cause, the matter is prevented from escaping, during the interval of dressing, it will obstruct the slow and gradual contraction of the sac, which necessarily precedes its cicatrization. In case the abscess bursts spontaneously, the lips of the opening show no disposition to adhere, and therefore all that is required, for a time, at least, is the application of the poultice. This should be continued, in the phlegmonous abscess, until the cavity is nearly obliterated, or until its parietes have become relaxed by the long application of heat and moisture. Under such circumstances the poultice should be abandoned, and dressings of simple cerate substituted, which must be supported by a well-adjusted roller. If there be sinuses, compresses should be placed over their tracks, which are to be sustained by firm and long-continued pressure. Should this not succeed, it may be necessary to lay the sinus open throughout its whole extent, by means of a director and bistoury.

Notwithstanding the judicious employment of the means already indicated, great difficulty is experienced, at times, in healing certain abscesses. The skin becomes detached for a considerable distance from the subjacent tissue—exhibits a livid aspect—the granulations beneath are smooth and pallid—the matter which issues from it is thin and offensive. This may be occasioned by the lodgment of a foreign substance in the bottom of the abscess. When this is the case, it must be removed without delay; the diseased skin must be ex-

cised by the knife or destroyed by caustic, and gently stimulating dressings applied. If the patient's general health is impaired —if the tissues of the viscera are altered by disease—we cannot expect to heal the abscess before his general health is improved. This is not the place to detail the means by which such an end can be accomplished. (See *Ulcers.*)

Thomas Harris.

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I. H.

ABSCISSION. (From *abscidere*, to cut off.) The cutting away of a part, more especially of a soft part. This is the only signification in which it is at present employed, though formerly used in several others.

I. H.

ABSORBENTS. (*Mat. Med.*) This term has been applied indiscriminately to two distinct classes of remedial substances. The first are articles which, when internally administered, have the property of chemically combining with, and thus destroying or neutralizing those acid secretions, which are produced in certain morbid conditions of the digestive canal. As, however, most recent writers on Materia Medica have considered these remedies under the appropriate name of *Antacids*, they will be treated of under that head.

The second class includes all those external applications which are made use of in ulcers, gangrene, (q.v.) &c., not only to arrest the progress of the disease, but also to prevent the patient or his attendants from suffering from the fetid discharges.

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R. E. Griffith.

ABSORBENT VESSELS. (See *Lacteals* and *Lymphatics.*)

ABSORPTION. *Absorptio*, Lat. (From *absorbere*, literally, to drink up, to swallow, to absorb.) Absorption is an organic phenomenon, usually classed with the functions. If we view this process, however, as a property attached to every particle of organized structure, and not as the office of an especial organ or apparatus, it cannot be regarded as a functional action, but as a vital and organic phenomenon.

A state of vital activity is one of incessant change. Organic structure in the acts of vitality is undergoing constant renovation, and sometimes modifications. In this respect, organic, for the most part, contrast strongly with inorganic bodies. These last preserve their forms and composition only when in a state of absolute quiescence: action destroys both form and composition. Organic bodies, on the other hand, maintain their existence by action. When motion or action terminates in them, they cease to exist as organized bodies. Their form and structure are lost.

The vital reaction of living bodies exhibits two well-characterized phenomena. 1. Attraction of new materials derived from exterior elements, and their appropriation to the composition of organic tissues. 2. Rejection and elimination of the old materials, whose aptitude for vital activity is destroyed, and of those substances accidentally introduced, inapposite to vital structure. In this manner is accomplished a renewal or reconstruction of the tissues, or organic elements, the object of the vital actions. They are consequently always formative, and must be dependent on another phenomenon for the introduction of the exterior elements, and the removal of the rejected matters. This phenomenon is absorption, a term that has less applicability to this view of it, than when it is regarded in the light of a function.

Absorption is a physiological phenomenon, too obvious to have escaped even superficial observation. Its existence has been recognized from the earliest periods. Hippocrates speaks of the inhalation of vapours and fluids not only from the external, but from all the internal surfaces. Galen adopted his views, and entered into a fuller explanation. It was received by subsequent writers as a fixed principle, and formed a conspicuous portion of most systems of pathology and therapeutics, and especially in specific and contagious diseases.

The intimate association and dependence of the nutrition of organized structure on absorption, renders this process common to every living being. None, in active existence, can be developed or maintained, except from exterior matters whose molecules are seized on and con-

veyed into them by absorption. This process is not, then, exclusive, attached to any one class of beings; it is common to all, vegetable and animal; and belongs equally to the first rudiments of the embryon, and the being in its most perfect state of development. Neither is it the exclusive property of any one tissue; it is a property common to all, has its seat on all the surfaces, external and internal, and in the interior of the parenchymas.

Extensive and diversified in its seat, it must, consequently, present some diversities in its phenomena, without, however, varying in its essential nature. In all its modifications, absorption is nearly, if not entirely, an identical process. Various divisions have been made of this process, but it must not be understood that they are indicative of any essential distinction. It has been separated under the heads of external absorption, as occurring from the external skin and internal skin, or mucous membranes, lining the cavities in relation with external agents; and internal absorption, or as exercised on the materials of the parenchymas, and internal structure of the tissues. It has been named nutritive absorption and incidental, as concurring in the aid of nutrition, or as displayed on foreign matters incidentally presented to the surfaces. It has been treated as venous absorption, or executed by the veins; and lymphatic absorption, or as performed by the lymphatics.

The view we shall take of this phenomenon will be more satisfactorily elucidated by considering it under the following arrangement. 1. The seat or location of absorption. 2. The mechanism of absorption. 3. Its physiological, therapeutic, and pathological relations.

§ I. *The seat or location of absorption.* This process is manifested in all the membranes constituting so considerable a portion of the economy, and executing some of the principal of the organic functions. These are, 1, the external dermoid membrane, or skin forming the exterior superficies; 2, the internal dermoid membrane, or mucous membranes, lining the interior surfaces, or cavities communicating with the exterior; 3, the generative tissue, or cellular membrane, forming so extensive an element of all the organs, and spread throughout the whole economy, being the web or origin of every other tissue; 4, the serous membranes, a condensation merely of the preceding, lining the splanchnic cavities, and furnishing a covering to their contained organs; 5, the vascular tissue, or coats of arteries and veins; and, lastly, 6, the interstitial, intimate, and parenchymatous structure.

A few observations may be required to explain more fully the phenomena of absorption, as exhibited in these various situations.

1. *Absorption as manifested in the external dermoid membrane or skin.* From the earliest periods cutaneous absorption was received as an unquestioned fact. Applications of remedies were made to the skin, intended to operate on various organs. This practice was a favourite method of acting on the economy with the Arabian practitioners. They applied to the skin medicines intended to exert their influence on the bowels as purgatives, on the lungs as expectorants, and on the kidneys as diuretics. This therapeutic method, although much neglected, was not entirely forgotten, and, in our time, has been revived and advocated by Brera, Alibert, and especially by Chrestien, in a work rich in observations and experiments, written expressly on the "Iatraleptic Method," or administration of remedies by cutaneous absorption.

The generally received doctrine of cutaneous absorption, was first impugned by Seguin, and nearly at the same time was controverted by Rousseau in his inaugural thesis published in 1800. Dr. J. Klapp, of Philadelphia, in 1805, resumed and extended the investigation in his thesis, and the same subject was treated by Dr. Dangerfield. The result of these various publications was to throw, for a period, very strong doubts on the existence of this phenomenon; and they have certainly shown that it is not as universal as it was previously supposed to be. Many of the facts that were regarded as evidences of cutaneous absorption, they have proved to depend on pulmonary absorption, from the introduction of vapours into the lungs. In denying, however, in toto, cutaneous absorption, and attributing solely to pulmonary absorption all the effects on the general economy following the application of substances to the skin, they have arrived at a conclusion that cannot be justified by the facts.

That the skin is endowed with active absorbing faculties, no one, at the present day, will deny; and the only question to be resolved in this controversy is, whether the cuticle intended as a general protection to the skin, acts so completely as a defence, as to oppose, under all circumstances, the introduction by absorption, of all substances in contact with it. This certainly cannot be positively affirmed.

No fact is better substantiated, than that various medicinal substances applied by friction to the skin, will display their peculiar effects on the whole economy, or particular organs. The mercurial frictions are too noted almost to be adduced in illustration. It is vain to assert, that the development of the mercurial action is always the result of absorption from the lungs, the metal being vapourized. Entangled in fatty matters this is not likely to occur. Besides, were this the fact, patients occupying the same ward, and the adjoining bed, and the nurses who make the frictions, should be salivated as well as the one on whom the frictions are made. Yet such occurrences are very rare, if the precaution is taken to protect the hand by a glove, of the person applying the friction. Neither are the labourers employed by the druggists in the preparation of mercurial ointment and blue mass, who are often occupied in rubbing up the metal in mortars for days and even weeks, ever affected, as they would be, were salivation induced by frictions caused by the vaporization, in these instances, of the metal, and its inhalation into the lungs.

The cuticle is not in every part equally dense: around the genital organs, or the insides of the thigh, beneath the axilla, on the mammæ and the lips, the cuticle is of a more delicate organization, and when applied to these parts, repeated experiments have established that medicinal substances produce most certainly their proper operation. In a series of experiments by Dr. Mussey, of Massachusetts, the absorption of the colouring matter of rhubarb, was clearly shown to take place from the skin.

On a review of the whole controversy on cutaneous absorption, it may be concluded, that while the epidermis diminishes very materially the absorbing activity of the external surface, and entirely abolishes it for some substances, that still it is manifested under certain circumstances, is favoured by frictions and bathing which soften the cuticle, and that it does occur with great constancy in particular parts and for other substances.

When the epidermis is removed, and the skin is denuded, the mechanical obstruction it opposes to the acts of absorption being destroyed, this process is, then, displayed with decided energy. A great variety of matters are then introduced into the economy, either affecting it with disease, if they possess morbific properties, or which may operate a therapeutic action, when of a medicinal character. This therapeutic method of bringing into play the remedial agencies of medicines, was introduced, a few years since, by Dr. Lembert, and has now settled down into a received practice, under the name of *endermic medication.* It offers a most valuable resource to the practitioner in a great variety of cases.

In animals whose skin is moist, and which possesses a very delicate cuticle, cutaneous absorption is a constant and important function. Such are frogs, salamanders, and similar animals. The experiments of Edwards have established the skin in them to be entirely absorbing, and instrumental in their support. It is the opinion of Fohmann, that, while the fœtus is in utero, cutaneous absorption from the liquor amnios, by which it is surrounded, is one of the means of its nutrition.

2. *Absorption as manifested in the internal dermoid membrane, or the mucous membranes.*

a. Of pulmonary or bronchial absorption. The bronchial mucous membrane presents all the conditions of an absorbing surface in the highest degree, and is one of the most active of those executing this office. The physiological or normal absorption of this surface, for which it is specifically provided, is that of the atmospheric air, in the function of respiration. This fact was long considered doubtful. In the theory of Crawford, and those of which it was the basis, no absorption of the air was supposed to exist. The changes it underwent were attributed to actions exterior to the mucous membrane, in the area of the lungs. The carbon of the blood eliminated into the lungs, there united with the oxygen of the atmospheric air that had penetrated into their cavity. From the later researches of Davy, Edwards, and others, it is now the received doctrine, that the oxygen, if not all the components of the atmosphere, is absorbed by the mucous membrane, and thus entering the blood, unites with it. In this doctrine the absorption of the bronchial mucous membrane is no unimportant operation in the function of respiration, and whatever condition of this structure interferes with or prevents the exercise of its absorbing powers, immediately affects the whole function of respiration.

Absorption of the bronchial mucous membrane is not confined to atmospheric air exclusively. Numerous other substances presented to it in the form of vapour or gas, are likewise absorbed, introduced into the circulation, and, by this route, distributed throughout the economy. The vapour of spirits of turpentine has been proved, by the experiments of Bichat, Rousseau, and Klapp, to be absorbed by

the pulmonary surface. The vapour of sulphuric ether, and nitrous oxide gas inhaled, very promptly exhibit their exciting and intoxicating effects on the brain, through the medium of the circulation. The vapours of ardent spirits, when breathed, have also been known to induce intoxication. Mercurial fumigations are resorted to for bringing the economy under the influence of that remedy; and, in the memorable instance of the crew of the British ship of war, salivated, and otherwise affected by mercurial vapours proceeding from a quantity of that metal loose in the hold, we have a strong evidence of the absorption of that metal by the bronchial mucous membrane. Mr. ACHARD, in the *Journal de Physique*, Oct. 1782, relates, that he was salivated by the vapours of mercury arising from a quantity contained in a dish he had left over a furnace, daily heated, the temperature 72° F. (*Bibliotheque Universelle*, Janvier, 1818,) MEYER, in his experiments, injected small quantities of the solutions of different salts into the bronchial tubes, which he proved to have been absorbed by detecting them in the blood. These, and other strong instances that might be adduced, attest sufficiently the active absorbing powers of the bronchial mucous membrane.

b. Of alimentary absorption. The mucous membrane of the alimentary canal, takes precedence of all the surfaces in relation with the exterior, in the acts of absorption. In structure, it possesses all the requisites for the exercise of this process. It is the seat of the nutritive absorption, destined for the reparation of the animal tissues, and is, consequently, the great portal giving entrance into the interior of the economy.

All portions of the extended surface of this continuous tube, from the lips to the anal termination, are absorbing; but the stomach, small and large intestines, from admitting the prolonged contact of the matters they receive, are the most conspicuous for their absorbing energy.

In the stomach, the solid food does not present the conditions adapted for absorption, and is retained to bring it into that state, which is its molecular disintegration. This is the principal, if not exclusive end of digestion. But the drinks and other liquids, many colouring bodies, medicinal and other substances, whose materials are capable of penetrating the gastric mucous membrane, are rapidly absorbed, and carried into the interior of the organism. Those of them endowed with active properties, display their influence on the organs with which they possess relations; others appear in the secretions eliminated by secerning organs from the economy. The rapidity with which fluids and colouring substances pass from the stomach to the bladder, is such as to have puzzled physiologists not a little to account for the phenomenon. DARWIN resorted to the hypothesis of a retroverted action of the absorbents. SIR EVERARD HOME suggested a direct communication by means of vessels between the stomach and bladder, which LIPPI pretends, but we believe with FOHMANN, incorrectly, to have discovered passing from the digestive organs to the pelves of the kidneys; and MAGENDIE was directed by it to his experiments, which eventuated in the renovation of the exploded doctrine of venous absorption. In the experiments of HOME and MAGENDIE, repeated and confirmed in Philadelphia by LAWRENCE, and COATES, various substances placed in the stomach, were detected in the urine in the space of from four to six minutes.

The absorbing faculty of the small intestines is not less active than that of the stomach. The aliment, reduced by the processes of digestion to its molecular state, is rendered capable of penetrating their mucous membranes. It is freely taken up. The lacteals, which appear to be the organs of chylosis, or the apparatus for the preparation of the chyle from the nutritive molecules, are to be seen, at this time, filled with that fluid; and, in a short period, the whole nutritive product of digestion is removed from the alimentary canal. The absorbing power of the small intestines, is not restricted to the imbibing of chyle only. Experiments have demonstrated, that it shows an equal activity for numerous active principles when they are applied to that surface.

In the large intestines occurs the last of the series of digestions, or processes through which the alimentary matters pass for the complete evolution of the nutritive elements they contain. The result is fecation, and the entire separation of all the nutritive principles from the innutritive matters. The first are absorbed, the last rejected. Besides normal or physiological absorption, in regular activity, whenever foreign matters are addressed to this surface, many of them are immediately absorbed and carried into the economy. Tonics, narcotics, stimulants, diuretics, and other medicinal substances, when thrown into the rectum, will act on the organs they specifically affect, with nearly as much certainty and promptness as when addressed to the stomach.

Other mucous surfaces, as the genito-urinary, are also absorbing surfaces, though it is rarely possible that foreign matters, with the exception of some specific virus, are, or should be, introduced into the organism by this route.

3. *Absorption in cellular tissue.* The absorbing powers of the generative or cellular tissue, are of unquestioned activity. Fluids of various kinds so often effused into this tissue, are rapidly taken up, and eliminated by the kidneys, or skin, or bowels. Tumours of different kinds, nearly all of which arise in the cellular tissue, and are formed by its degeneration, and the secretion into its meshes of various fluids and matters, disappear very frequently, even when they have acquired a considerable bulk. This must have been accomplished by absorption. Blood, which is often effused into the cellular tissue; and air, that has escaped into it, forming emphysema, disappear by the process of absorption. Various active medicinal principles, when they are placed in the cellular tissue in the groin, thigh, or other parts of animals, will exhibit their specific actions in distinct organs. A solution of emetin injected, by MAGENDIE, in the cellular tissue of the thigh of a dog, excited vomiting in nearly as short a time as when introduced into the stomach. A solution of strychnine placed in the cellular membrane, in any portion of the body, in a few minutes, produces tetanic spasms, by its action on the spinal marrow, which is influenced by the poison in consequence of its absorption. The absorption of the cellular tissue is fully established.

4. *Absorption in serous tissue.* The serous membranes, a condensed modification of the generative or cellular tissue, lining all cavities, and coating all viscera and organs liable to movements, are endowed with powers of absorption in an active degree. These membranes are lubricated by a viscous serosity exhaled on their surface, admirably adapting them to easy motion by preventing all friction, and this exhalation is constantly renewed. Absorption is equally active, or its accumulation would be inevitable. In a pathological state, serous and other effusions are often products from these membranes, constituting the dropsical affections. Yet, these effusions, when they even exist to a great extent, are frequently removed in a short period. The water of ascites, and of hydrothorax, after great accumulation, and it is not an uncommon occurrence, is rapidly absorbed, and the effusion, at least for a time, removed.

Absorption in the serous tissues is not confined solely to the fluids they exhale. Various substances, when applied to them, are carried rapidly into the general economy, and display their peculiar mode of activity. Solution of emetin introduced into the peritoneum, or pleuræ, excites vomiting as speedily as when taken into the stomach. Strynine applied to these surfaces a few minutes, is productive of tetanic spasms. Dr. J. K. MITCHELL, of Philadelphia, injected into one of the pleuræ of a rabbit, a solution of sulphate of iron, and into the peritoneum a solution of prussiate of potassa. The veins spread on the diaphragm, were of a beautiful blue, from the Prussian blue, formed by the reciprocal action of these substances, absorbed from the serous tissues, and carried into the circulating vessels of the part. Absorption is thus demonstrated as a process equally active, and as general in the serous as in the cellular tissue and dermoid membranes.

5. *Absorption in the vascular tissue.* The phenomenon of absorption belongs also to the vascular structure. This was to be expected, as the vessels are composed of serous tissue, (the inner coat,) fibrous tissue, (the middle,) and cellular tissue, (the external); the two first being also mere modifications of the last. The fact is proved by the application of the solution of strychnine to a denuded vein or artery. The specific action of the medicine is very soon brought into operation. I have proved the same fact for colouring substances.

6. *Nutritive absorption.* In the nutrition of the tissues by which they are renewed, a simultaneous process of composition and of decomposition is going on. The animal organic molecules that have composed the tissues disappear, to be replaced by new ones furnished by the aliment. The original ones pass into the general circulation, and are eliminated in the form of the excretions. This removal of the constituent molecules is the work of absorption, which thus enters into the series of acts that compose nutrition. Absorption consequently is not confined to the surfaces of the organism, but occurs in every portion of the organization, in the profound and intimate structure. Interstitial absorption is at work in the hardest as in the softest of the organs, in bones and cartilages as in mucous membranes and nervous medulla. By this process, the bones of the cranium are adapted to the changing form of the brain. Bones are removed entirely, when the growth or enlargement of the soft parts produces pressure, as in tumours and aneurisms; and they vary in their form, consistency, and

colour, in different epochs of life, and from diseases, food, and other circumstances. The same effects are to be noted in the muscles that diminish in size, and in the nerves that are atrophied under particular conditions. The same circumstances are to be observed in the glandular parenchyma, in the adipose tissue, and, in fact, in every structure, and can have no other explanation than the incessant action of absorption exerted on the separate molecules of each distinct tissue and organ.

Interstitial absorption is but rarely manifested, except in the physiological order. Coagula of blood, effused into the medullary portion of the brain, in apoplexy, are, however, sometimes removed by absorption. The fact has been established by SERRES; and, in the bites of venomous animals, and the wounds of poisoned weapons, the deleterious agent deposited beneath the skin and in the muscles, is taken up by interstitial absorption, conveyed into the blood, infects that fluid, destroying its capacity for the maintenance of vital activity. The numerous, varied, and well-devised experiments of FONTANA have cleared all doubts on this point.

§ II. *Mechanism of Absorption.* Absorption was attributed, by HIPPOCRATES, to the veins. The same doctrine was adopted by GALEN, and was received with implicit belief in the subsequent eras of the science. The first to call in question this generally adopted opinion, was Dr. WILLIAM HUNTER, whose brother, JOHN HUNTER, was supposed to have overthrown it in the most signal manner, by experiments. For venous absorption, which was denied in toto, they substituted absorption by the lymphatics, which then received the name of absorbing vessels. CRUIKSHANK, a pupil of Dr. HUNTER, in his fine work on the absorbents, embraced the doctrine of his preceptor, and warmly supported it.

The views of the HUNTERS were the acknowledged principles of the age, contested by none. Venous absorption was looked on as an exploded error of the schools, and the lymphatics, or as they were more frequently and emphatically termed, absorbents, were considered as the exclusive agents in the performance of this office. Such was the doctrine of absorption until the actual period.

Lymphatic absorption, bolstered, as it was supposed, by irrefutable facts and arguments, was subjected to a new scrutiny. MAGENDIE instituted a series of experiments, the results of which led him, not only to assert the existence of venous absorption, but he denied the same function to the lymphatics. SEGALAS followed in the same track, and confirmed the accuracy of MAGENDIE's observations; and, reinvestigated in this city, by Doctors LAWRANCE, COATES, and HARLAN, the facts demonstrative of venous absorption were indubitably established. The American experimenters further exhibited the source of delusion which probably misled JOHN HUNTER, in one of his most important experiments.

It was not long before it was perceived that the ground occupied by MAGENDIE was too narrow, and did not include all the phenomena of absorption. He was himself amongst the first to enlarge his views on the subject, and he established by new observations that absorption was not confined exclusively to the veins, but that the lymphatics partook of it, along with every species of structure; and finally he has settled in the conviction that it does not essentially differ from imbibition.

Absorption is still regarded by some physiologists as a function of the lymphatics, and it is attempted to sustain this doctrine on anatomical considerations. LIPPI pretends, as has been already remarked, to have discovered absorbent vessels passing directly from the digestive organs to the pelves of the kidneys, and other lymphatics communicating with venous trunks. By these routes matters taken up by the lymphatics are directly conducted into the veins, and the facts regarded as illustrative of venous absorption may be thus explained. The alleged discoveries of LIPPI, although they received the approbation of the Academy of Sciences of Paris in 1829, are denied so positively by the superior authorities of FOHMANN and LAUTH that they cannot be admitted.

But while FOHMANN refutes LIPPI, he is himself an advocate of lymphatic absorption, and he accounts for the phenomena supposed to result from venous absorption by an anatomical arrangement totally different. From his indefatigable investigations he has discovered lymphatics in tissues and organs where they were before unknown; in the transparent cornea, conjunctiva, serous membranes, inner coats of vessels, and placenta. The lymphatics thus abound in every part of the body. The two MECKELS (grandfather and father) had recognized in a few lymphatic glands a direct communication with the veins. VROLIK had made the same observation on the mesentery in the body of a woman; and Abernethy had demonstrated the phenomenon in examining the large mesaraiic gland

of a whale. These facts FOHMANN fully confirmed in repeated investigations, although he differed as to the *mode* of communication. He deduced in consequence this proposition, that in man and in the mamiferæ the communications between the lymphatics of the veins, except in the clavicular regions, are limited exclusively to the absorbent glands. By this immediate communication existing in the lymphatic glands, between the lymphatics and veins, FOHMANN conceives may be explained the facts that show the introduction of substances into the circulation, that could not have passed by the thoracic duct.

By the anatomical structure of the lymphatic glands a direct communication between the lymphatics and veins must be admitted to exist. The authority in support of the fact is too respectable to be rejected. In this manner many substances, probably not requiring it, may be introduced into the economy without previous elaboration, while others must be previously subjected to the actions of the glands and lymphatics. Yet it does not follow because this arrangement may exist, that absorption is restricted entirely to the lymphatics, and no substances can enter the circulation except introduced through the medium of the lymphatics. In the experiments of MAGENDIE a circumvolution of intestine was isolated from the remainder of the alimentary canal, and a portion of the extract of nux vomica introduced into it. All the connecting parts, except a single artery and vein, were also removed, yet in the usual period, six to ten minutes, the convulsive movements that substance excites by its introduction in the circulation ensued. The communication between the lymphatics and veins through the glands was here cut off, and yet the poison had been absorbed and carried into the blood. This experiment having been repeatedly verified, cannot be questioned, and the absorption of the poison consequently must have been independent of lymphatic absorption in the manner advocated by FOHMANN.

In order to test the correctness of FOHMANN's doctrine, assisted by Dr. MUTTER I made the following experiment. The external jugular vein of a full-grown ram was laid bare, and completely isolated from the surrounding structure. A pledget of muslin was passed under it, and a ligature applied to its lower portion. The external coat of the vein was then touched with a solution of prussiate of potash, and a ligature distant two inches from the first was passed round the other extremity. The portion of vein between the two ligatures was then removed. The blood contained in it was emptied into a glazed cup. The internal membrane of the vein, touched with a solution of sulphate of iron, immediately became blue. After standing half an hour, the serum which had separated from the blood was also tested with the sulphate of iron, and the blue precipitate instantly took place. The prussiate of potash had therefore passed immediately through the coats of the vein, and had been mingled with the blood. The mode of introduction, asserted by FOHMANN as that by which alone substances can enter the circulation, did not exist in this instance. This is the last effort to sustain exclusive lymphatic absorption; a doctrine which, it appears to us, must be abandoned.

Physical, chemical, and vital phenomena, though apparently widely separated, are probably more nearly associated than they are now supposed to be. Advanced as is our knowledge of the physical and chemical phenomena of the universe, infinitely more remains to be known, and when developed, the wide space that now separates them from the phenomena of organized bodies, classed as vital, may, it is probable, be reduced to a mere artificial division. Most of the phenomena of organized bodies, or vital phenomena, as connected with their organization, with the exception, possibly, of the first or ultimate phenomenon, are no more than physical and chemical phenomena occurring under new relations. They should be considered as such, and their explanation be always made on physical and chemical principles. Organic bodies are composed of the same physical and chemical matters as compose inorganic bodies. The fact of their arrangement as organic matter does not divest them of their properties or character as the subjects of the universal operations of physical and chemical laws, and which they must obey in their organized state. Physical and chemical phenomena are in their most perfect state and exalted condition in organized beings, especially in the organisms of the most elevated beings.

Metaphysicians, by a *mental abstraction*, have made solidity and impenetrability properties of matter. This is, however, mere scholastic subtlety So far as matter can be brought to our positive knowledge by the senses, porosity and penetrability are its constant properties. We have what may be regarded as almost the demonstration of the fact in the experiments of GRAHAM and DALTON, but more especially in the very ingenious experiments of our intelligent collaborator DR. J. K. MITCHELL,

of this city, exhibiting the penetrativeness of the gases; and in the experiments of Dutrochet on the endosmose and exosmose of fluids through animal and vegetable tissues.

It may be inferred from these experiments, that whatever may be the properties of matter in its ultimate atoms, of which we know nothing, that *bodies*, whether inorganic or organic, are porous and penetrable by some other substances or matters. This property is not a mere passive one, but is active and incessantly in action, although exercised with different ratios in respect to different bodies. All bodies are consequently absorptive, actively imbibing or respiring in ratios definite for each substance.

Organic bodies exhibit this general physical phenomenon, in its most perfect and active condition. The organic element of every tissue, vegetable or animal, is, as far as our means of investigation carry us, a spherical vesicle, with imperforated walls, imbibing or aspiring with a species of selection the exterior matters with which it is in relation, elaborating in its interior such as are of its own nature, expiring or ejecting others. Such is the result of the demonstrative experiments and observations of Raspail, in his admirable work "*Chimie Organique*." The properties of a tissue are no more than the aggregate of the properties of each of its constituent molecules, and absorption is consequently a property of every organized tissue. It is now seen why, in the beginning of this article, absorption was asserted to be an organic and not a functional phenomenon.

In the simpler forms of animals, the principal vital phenomena consist in imbibition or aspiration, and expiration. In the animals of more complex structure, the phenomena cease to be simple. Several are combined, so as to constitute apparently but a single phenomenon, and can be properly appreciated only when reduced to the expression of their simple state. Such is absorption in the mammalia. It is a compound phenomenon, composed of imbibition or aspiration, and circulation. The animal tissues are permeated by the fluids constantly in motion, conveying to the separate molecules the elements for their nutrition to be selected by aspiration. The substances penetrating the tissues through their pores, taken up by imbibition or aspiration, are conveyed into these currents of fluids permeating the tissues. Those that are soluble or mixable with the fluids are dissolved in or united to them, are carried rapidly into the vascular or general circulation, diffused throughout the economy, and produce often in a few minutes their specific action on the particular organs with which they possess relations from their inherent powers. Others that are insoluble, or immixable with the fluids, penetrate but slowly into the interior of the organism, or they remain in the tissues exciting only a local impression.

The fluids penetrating and permeating the tissues, are the red blood, and white blood or lymph, mixed together in the large vessels and highly vascular organs, but separated in the tissues. The vessels which give to their movements a centripetal direction are veins for red blood, lymphatics for the white blood. The substances absorbed into the tissues may, according to circumstances not yet established by experiments, be carried into the lymphatic circulation, or into the venous circulation; and the one or the other may be the means of diffusing them throughout the economy.

The lymphatic system may exercise other offices than that of mere vessels. The numerous glands composing so large a portion of the system indicate other operations. Their presence is an obstacle to the free movement of the fluids in the lymphatics, and they are largely furnished with red blood, an indication always of some important function. They may exercise digestive or other action on the matters absorbed.

Lacteal absorption appears to possess something of a specific character. According to numerous experiments, colouring and other substances introduced into the intestines are never detected in the lacteals. The contents of the latter are exclusively chyle. These experiments require to be repeated. The observations have been made on the contents of the efferent vessels proceeding from the mesenteric glands; the fluid of the afferent vessels, or those conveying the matters absorbed from the intestines to the mesenteric glands, has been overlooked. Now, it is completely established, that in the glands a direct communication exists with the veins, and other substances than the chyle taken up by the lacteals may, in this manner, pass into the veins, and not appear in the efferent lacteals. Chyle, the fluid found in the lacteals, is not prepared by the digestions of the alimentary canal. It is not absorbed as perfect chyle from the intestines. It is elaborated in the lacteals or more properly the mesenteric glands. These last, then, (the efferent lacteals and mesenteric glands,) are the organs accomplishing chylosis, or the formation of perfect chyle from the crude production of the gastric, duodenal, and intestinal digestions.

The immediate active power operating the imbibition or absorption of bodies has not been demonstrated. It can at present only be conjectured. Dutrochet has supposed it to be electro-galvanism; and it is certain that this power causes the transport of fluids and even solid particles. It is a general physical law, shown in the researches of Dr. Mitchell, that gases and fluids penetrate each other in certain ratios, and it is well known that porous bodies possess the power of absorbing or imbibing and condensing both fluids and gases. Charcoal is a strong illustration of the fact; and even a fine crack in a bell glass, as Döbereiner first observed, will absorb and transmit a gas contained within the vessel.

Analogous to these physical laws, is the general organic law demonstrated by Raspail, that every organized vesicle—the organic atom—has the power of aspiring or imbibing, and expiring; a double and indivisible function. By this power may be conceived all the results of organization. The atomic organic vesicle aspires fluids and solids, condenses them, assimilates or unites to the product formed, and rejects by repulsion or expires the products foreign to its nature, or in other words unassimilable. These phenomena are positive. The active physical force productive of them, is undetermined. To call them *vital* is merely to acknowledge them unknown.

The absorption of substances from surfaces in the manner indicated, can be easily understood; but certain tumours, coagula of blood effused in the organs, the callus tophi, &c., surrounding recently fractured bones, are also removed by absorption. The manner in which bodies possessing considerable consistency and solidity are thus dissipated by the absorbing faculty, has not been satisfactorily explained. The common solution of the problem, that they are eaten up by the absorbents, is a supposition too gross to be admitted. It is not, however, all tumours that can be removed by absorption. Those that possess a certain degree of firmness and consistency, as the fibrous tumours, tuberculous deposits, encephaloid or medullary sarcoma, gelatinous fluid inclosed in fibrous cysts, all consisting of *insoluble materials*, are never taken up by absorption. The tumours most readily dispersed are the swellings of the lymphatic glands. These being cellular in structure, their enlargement is caused in most instances by accumulation of fluids in them, and hence they are more susceptible of dispersion by absorption.

The removal of coagula of blood effused in the brain, as in apoplexy, when the patient survives the attack for some time, is accomplished by a particular process observed by Serres. The cellular tissue condensed by the pressure, forms a membrane surrounding the coagulum. It then secretes a fluid, which, acting on the coagulum, dissolves it, reduces it to the fluid state, when it is susceptible of being absorbed, and must be absorbed. How far a similar mode of action may occur in other instances has not been ascertained, but it is by no means improbable that a corresponding mode of *digestion* may be exercised on the matters introduced into or deposited in the tissues. What appears to countenance this conjecture is, the impossibility of removing by absorption those morbid productions whose materials would resist strongly the disaggregating power of gastric digestion.

An experiment of Spallanzani is corroborative of this view. A calculus of a given weight was placed in a wound, which was then made to cicatrize. After a certain period the wound was reopened, and the calculus was found to be destroyed in form and greatly diminished in weight. A secretion had been established by the irritation it had caused, and the fluid thus formed had acted as a digestive juice.

§ 3. *Therapeutic and Pathological Relations.* 1. Absorption is intimately connected with the *therapeutics* of many medicinal substances. The greater portion of them possess specific relations with particular organs or tissues, acting on them exclusively in a specific mode. This relation would appear to consist in the adaptation of the properties or inherent powers of the medicinal substance to the mode of vitality of the tissue. But for the display of this relation, the molecules of the medicinal substance must be brought into immediate contact with the tissue it affects, and this is accomplished by its absorption.

In the higher animals, external absorption consists, as we have endeavoured to show, of two distinct processes—imbibition and circulation. The first is limited to the tissue, and is modified by the texture of the tissue. Every distinct tissue possesses different absorbent powers, depending probably on its texture, and enjoys a positive relation in this respect with different substances. This is a part only of a universal phenomenon. It is seen in the relations of various bodies in regard to light and heat. Bodies possess absorptive textures of different capacities for these matters; whence result the various colours, as certain rays are absorbed or reflected, and the varying conducting powers for heat. This differ-

ence in the absorptive texture of the different tissues, and even divisions of the same general structure, will account for the diversity of actions in many articles having nearly similar properties. Some affect the gastro-mucous membrane, when in contact with it; others, not very dissimilar, pass over that surface and influence the intestinal mucous membrane; and others display their activity only on that of the large intestines, leaving the other portions of the alimentary canal undisturbed. Some purgatives applied to the denuded cutaneous surface are absorbed and will purge; others excite a violent irritation on the skin, but do not occasion their specific action on the intestines—they are not absorbed. Tartar emetic applied to the skin, causes pustular irruptions, manifesting the energy of its active power, but does not in the least disorder the stomach. Its solution injected into the veins, excites immediate vomiting. Applied to the skin, it is not absorbed; it does not enter the circulation, or it would manifest its action in the stomach.

The absorption of medicines, necessary, in most instances, to their therapeutic actions, may be prevented, first, by the texture of the surface to which they are applied, and second, by the condition of the circulation. The texture is subject to frequent modifications, the result of a pathological state. It may be turgid from excess of fluid, arid from defect of secretion; it may be permanently changed, hardened, softened, altered into an anomalous structure: these, and other alterations in the texture, will affect the absorbing energies of the tissues or totally suspend them. In the congestions, and consequent remora of the circulation, so frequently existing in the gastro-intestinal mucous membrane, in the advanced period of fevers, medicinal substances and remedies addressed to that surface, fail to produce their effects. Patients in this state cannot be salivated, the mercurial medicine remains on the surface to which it is applied; stimulants, diuretics, diaphoretics, disappoint of their expected operation. Even fluids cease often to be absorbed, and accumulate in the stomach and intestines, where they are found with the remedies administered before death. The tolerance, as it has been termed, of many medicines, which at first give rise to great disturbance, may proceed from this cause. The local irritation and inflammation they excite, provoking a congestion of the surface and stagnation of the circulation in the tissue, suspend its absorption, and, consequently, their action is restricted to a merely local impression on a very limited space.

The condition of the circulation will also further influence the therapeutic action of remedies depending on their absorption. If the circulation be arrested in a surface to which medicinal remedies are addressed, or greatly enfeebled by congestions, the consequence of irritation, or prolonged inflammation, or if the circulation be enfeebled from any other cause, the transportation and diffusion of the substance cannot be effected, and the therapeutic action must fail. The tissue may imbibe some of its molecules, but, if they be not constantly removed by the circulation, their continuous absorption must cease. These are some of the circumstances in which absorption interests therapeutics, and should possess a due weight in estimating the production of the therapeutic operation of remedial and medicinal agents.

2. In its *physiological* relations, absorption holds an elevated rank in the actions of the economy. It is, as has already been announced, one of the several acts which together constitute the compound phenomenon of nutrition. The elements of the organized tissues decomposed in the actions of life, are removed by its exercise, carried into the general circulation, and thence expelled in the forms of the excretions. The whole process of nutrition is directly connected with, and dependent on, its regular performance. Nutrition is indirectly not less dependent on this process. The nutritive principles derived from the exterior are introduced into the economy by means of absorption. The suspension of this process, by any of the causes that control it, vitiates or interrupts the whole phenomenon of nutrition. If not restored, a wasting and slow perishing of the being ensues. The well-being and existence of the whole economy, is thus dependent on the healthful and regular exercise of absorption.

3. Absorption, on the doctrine advocated in this article, must be intimately concerned in general pathology. Its special pathology is necessarily obscure, and must, in a great measure, be conjectural and suppositive. In general pathology, absorption associated with the organic phenomena, will be involved in all the aberrations they experience. A dependency of the texture and circulation must follow in the train of the modifications they are subjected to. The deviations it may undergo are its diminution and suspension, or its excessive activity. Diminution and suspension of absorption appear to be connected with

the congestion of the fluids, either red blood or lymph, induced by excess of irritation or inflammation. The fluids collect in the tissues the seat of the irritation, turgescence and erection ensue, a remora or stagnation results, and where erection is not a natural condition, the function of the organ is deeply assailed or totally lost. This state is seen displayed to the senses in the conjunctiva and in the fauces; it occurs in all the mucous membranes, and often in the skin. This condition frequently persists after the irritation that had provoked it has subsided. Various stimulants, some of the metallic salts, iodine, then applied, speedily dissipate the congestion, now become passive, by awakening the dormant powers of absorption. The stagnant fluids are removed from the disturbed and overloaded tissues, and the healthy functions are restored. These instances are often mistaken for inflammations, unaccountably cured by stimulants.

The lymphatic congestions, so often productive of glandular swellings and the colourless tumefactions of greater or less extent observed in the skin so frequently, in individuals of the lymphatic temperament, are of the same character.

Collections of serous fluids occur in the cellular tissue, and serous cysts, constituting dropsical effusions. Defective or suspended absorption has long figured in the systematic works, as a common cause of the disease. It must be confessed that the explanation partakes more of hypothesis than demonstration. The pathology of dropsy is certainly complex: its causes are various. A vice of nutrition and impoverished state of the blood, producing an exhaustion of the fibrin, hematosin in the solid portions of that fluid, with great predominance of the watery element leading to its effusion, is one of the most usual of the causes of dropsies. An obstruction or serious embarrassment to the return of the fluids by the veins or lymphatics, will also occasion the collection of fluids, constituting œdema and even dropsy of the cavities. In these last instances, absorption may be suspended from its dependency on the circulation. That dropsy is ever the result of a suspension of absorption alone, or simply from a loss in the equipoise of secretion or exhalation, and absorption, must be considered as extremely equivocal. No facts justify the conclusion.

Depositions of albuminous or other viscid humours, into the cellular tissue and in the skin, in certain climates, are of frequent occurrence. They are not removable by absorption, and continue to accumulate, producing great enlargements of the limbs and other deformities. Such are the eliphantiasis of the Arabs, glandular disease of Barbadoes, and leprosy of the Greeks. Alard and Hendy regard them as diseases of the lymphatics and lymphatic glands.

The internal surfaces manifest at times defective absorption. The bronchial mucous membrane, in the advance of malignant fevers, and occasionally in other fevers, appears to be divested of its absorbing character. The blood experiences little change in its character, and the air is expired as it entered.

In the gastro-intestinal mucous membrane, absorption is sometimes lost or impaired in the manifold changes that structure is liable to. I have witnessed cases of excessive emaciation, continuing for a length of time with an apparent integrity of every other function, of digestion, fecation, circulation, secretion, and innervation, which I was disposed to assign to defective absorption. In other cases, I have been disposed to believe that digestion and absorption have been rendered imperfect by the secretion of excessively viscid and tenacious mucus in great abundance, lining and adhering to the gastric and intestinal surfaces. These cases, relieved by active and drastic purgation with emetics, carrying off large quantities of mucous secretions, and followed with rapid restoration of flesh and embonpoint, have appeared to me to depend on the cause assigned.

It may be considered as doubtful, whether the excess, or too great activity of absorption, exists alone as a pathological condition; at least, facts are wanting to establish such a category. In some cases, swellings of the testicles are followed with complete absorption and disappearance of the organ. This would seem to be a case of absorption existing in morbid activity.

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I. H.

ABSTINENCE. (From *abstinere*, to abstain.) In its most extensive signification, this term may be applied to every kind of privation; use has, however, restricted its application, almost exclusively, to the privation of food and drinks.

This article will be devoted to the consideration of the extent to which abstinence may be carried, the functional and organic changes it produces, the means of remedying its morbid effects, and its advantages and inconveniences as a remedial measure.

§ 1. *To what extent can abstinence be carried?* This question it will be found does not admit of any precise solution. Numerous instances are on record of abstinence, for an extraordinary length of time; and although many of these are indebted for the credit they have obtained, to the love of the marvellous, natural to the human mind, there are others, sustained by such satisfactory evidence, so carefully observed, every source of error guarded against, that we cannot refuse them our belief. THEVENOT asserts that the Arabs can remain five days without food; and others that the Tartars support abstinence for fifteen, sixteen, and even seventeen days. A woman survived nearly eight days, buried in the snow without food. (OKES, *Duncan's Annals*, IV. 500.) A young man, confined in a coal-pit, by a sudden burst of water into it, remained twelve days without any other sustenance than a little water, which trickled down a rock and was collected by him in the hollow of his hand. (T. T. GRIFFITH. *Lond. Med. and Phys. J.* Feb. 1830, and *Eclectic Repertory*, X. 327. Philadelphia, 1820.) A woman who lost her way in a coal-pit, remained for eighteen days without any

nourishment except a little of her own milk for the first three days, and water subsequently. (Rankine. *Annals of Med.* VIII. 492. Edinburgh, 1804.) A maniac in the Lunatic Asylum at Montrose, often abstained from every kind of food, both solid and liquid, for fourteen days in succession, (*Ann. of Med.* V. 383.), and Plot speaks of a melancholic person who fasted for the same period. Cheyne states that a phthisical patient lived thirty days upon water with a little nitre dissolved in it. (*Diseases of body and mind*, p. 109.) Dr. Francis quotes the case of a negro woman who, supposing herself affected with *Obi*, refused all sustenance for seven weeks, during all which period she took for her support only about two cups of water slightly medicated with wine. (*New-York Med. and Phys. Journ.* for 1823, II. 21.) A young woman, whose case is recorded by Dr. Eccles, (*Med. Ess. and Obs.* V. art. XLIII.) was affected with spasms of the œsophagus to such a degree as to be unable to swallow, and remained thirty-four days without taking any nourishment. The spasms then abated, and she continued to take some food for about three weeks, when the spasms returned, and for fifty-four days she was unable to eat or drink. In a case related by Prof. M'Naughton, a man lived fifty-four days on water (*American Journ. Med. Sc.* VI. 543.); and in another quoted by Valisnieri, the patient lived for seventy-six days. Borelli (*Cent.* III. Obs. 35.) gives an account of a case in which abstinence was continued for three months, and Mercardier (*Journ. de Méd.* XXIII. 133.) quotes another, prolonged for six months. Many instances of even more protracted abstinence are recorded. Schmalz relates two cases, one of a female who lived two years and a half without food or drink, and another, a female also, who was still alive at the period of his report, and who had not eaten or drunk for six years. (See *Am. Journ. Med. Sc.* for Nov. 1833.) In a case related by Vandermonde, (*Journ. de Méd.* XIII. 158.) abstinence was protracted for twenty-six years; but the most extraordinary of all is the one related by the Rev. Mr. Steill, (*Med. Essays and Obs.* V. art. XLIV.) in which the patient lived for fifty years, upon a little whey or milk and water. Haller has collected many cases of this description, and a still greater number have been recorded by subsequent writers. The cases, however, we have alluded to, most of which have an appearance of authenticity, are sufficient to show that it is utterly impossible to fix the limits to which abstinence in the human species can be carried.

The experiments of Magendie on animals, belonging to genera near to man, show that they cannot support abstinence beyond fourteen or fifteen days. Some large dogs, however, subjected to abstinence by M. Collard de Martigny, lived three, four, and five weeks, and even longer. This last experimentalist also found that the younger the animal, the shorter was the time that they could support abstinence, and the smaller the animal, whether of the same or different species, the shorter the period they could live without food. Of some capons subjected by Redi to complete abstinence from food and drink, none lived beyond the ninth day. One of these animals, however, to which he allowed some water, lived to the twentieth day. (*Dict. de Méd.* 2d ed. I. 286.)

Most of the remarkable cases of abstinence we have cited and the greater number of all those recorded by writers, were in sick persons; and daily observation shows that abstinence can be supported with greater ease in sickness than in health. Of all diseases, insanity, and melancholy, allow of the most protracted fasting. It is in histeric or melancholic girls, that instances of the longest abstinence have occurred. Hard study, the ardent pursuit of objects, love, ambition, exalted devotion, all powerful excitements of the brain, cause a forgetfulness of the wants of reparation. It is reported of Sir Isaac Newton, that when immersed in his studies he would forget his meals. Sleep is also favourable to protracted abstinence; it is well known that hibernating animals, as the marmot, &c., live without food during a whole season.

It may be laid down as a physiological axiom, that the more actively the organic actions are performed, the more urgent and imperious will be experienced the necessity of reparation. Hence, in early life abstinence cannot be borne so well as at a more advanced period. Hippocrates observed, that the younger a person is, the more irresistible is the sensation of hunger; and the experiments of Collard de Martigny, as we have already stated, show that the younger the animal, the sooner it dies from privation of food.

Women appear to support abstinence better than men, since we find more instances of prolonged abstinence in the former than in the latter. This may arise from women, generally, taking in health less food than men, and from their suffer-

ing less loss by secretions, in consequence of their less active life.

Cold would seem to be very favourable to prolonged abstinence, by its lessening all the organic actions, and abating the losses by perspiration, &c.

Moisture has also been supposed to be favourable to the prolongation of abstinence, in consequence, as some think, of absorption taking place in the lungs, and, according to others, from the skin. Be this as it may, the length of time which persons confined in damp places, have endured abstinence, seems to support the idea that moisture is somehow favourable. Various other circumstances, as the constitution of the individual, and his habits, the season, &c., exercise an influence upon the duration of abstinence; but we are not in possession of a sufficient number of facts to enable us to determine positively their precise effects.

§ 2. *Effects of abstinence upon the functions.* The effects of abstinence upon the functions are exceedingly diversified, being modified by a number of circumstances, as the age, sex, constitution, habitual regimen, profession, habitation, habits and state of health of the individual; and by climate, season, temperature, the period that food has been abstained from, whether the abstinence is voluntary or forced, &c. Complete abstinence in a healthy person, under circumstances which render it impossible for him to procure any food, produces, as described by M. Londe, the following phenomena, characterized by alternation of languor and excitement. "*First degree:* When the feeling of health and strength, which follow digestion have ceased, and the renewed sensation of hunger is not satisfied, this sensation becomes more and more acute, and, finally, painful; there is then a decrease in the activity of all the functions, absorption excepted; feebleness of the senses and of muscular power; the activity of the cerebral organs is diminished; the circulation and respiration are slower; and there is a diminution of animal heat and of the different secretions. These initial phenomena of recent abstinence cease the very instant that food is taken into the stomach, and before it can have undergone any alteration. The debility is as yet merely sympathetic; it is only a warning given to the chief of the organs of relation. *Second degree:* If abstinence is continued, the brain perceives in the stomach and in the hypochondria, a painful sensation, at first a gnawing, afterwards the most agonizing pain; all the preceding phenomena are aggravated; thus there is inaptitude to motion, and to all kind of labour; burning heat in the mouth and pharynx, the saliva becomes acrid; there is extreme thirst, dryness of skin, scantiness of urine, which produces a burning sensation when discharged; dryness of the conjunctiva; redness of the eyes. *Third degree:* Excitement of the brain, transmitted to the senses, to the muscles, &c., increased strength; wandering of the mind; the most disorderly actions." (*Dict. de Méd. et de Chirurg. Prat.* I. 103.) To these phenomena are sometimes joined the most furious madness; but this has been attributed, apparently with justice, to other causes than abstinence. Thus the madness with which the shipwrecked sailors of the Medusa were affected, and which led them to the commission of the most ferocious actions—to the destruction of their companions in misfortunes—to throw into the sea the little wine that was left for the sustenance of life, &c., &c., has been supposed by some writers, to have resulted rather from the influence of tropical heat, and the total privation of sleep, than simply from the want of food. Whatever may be the nature, however, of this delirium, it is soon followed by total prostration, and, finally, death, in a longer or shorter period.

With the phenomena just enumerated, other changes are taking place in the system. The blood is impoverished of its nutritive molecules, exhalation diminishes over the secretory surfaces and in the parenchyma of the organs; absorption, on the contrary, is considerably augmented; the cellular tissues are deprived of the materials they hold in reserve; the fat is first removed, and the other white fluids are absorbed in their turn; the molecules of all these secretions are again carried into the circulation, subjected to pulmonary action, and re-distributed to the organs for their nutrition. The exhalations soon cease, the fat and serum disappear, and all the soft parts become much diminished in size, the eyes sink in their orbits; all the bony prominences become more conspicuous, and the joints appear larger than natural. Absorption eventually appears to be exercised even upon the tissues and organs themselves. This universal and excessive absorption is excited by the urgent wants of the organism; the necessity of a supply of nutritive materials to the blood, and which causes the system to prey upon itself. A very curious instance of life being supported by the absorption of the fluids of the body, is related by Mr. Gran-

GER, in his *Elements of General Anatomy*, p. 139, as having occurred some years since, at Dover. A hog, weighing one hundred and sixty pounds, was buried under a portion of the cliff, which fell on its stye, for the long space of one hundred and sixty days. At the end of this time, being dug out, it weighed only forty pounds, and was emaciated, clean, and white. As there was neither food nor water in the stye when the cliff fell, this hog must have existed during the time mentioned, by the removal of the adipose and other fluids from their containing structures, into the circulating system. There is a limit, however, to this source of supply, and the blood, no longer renewed by external matters, diminishes in quantity and acquires irritating properties. Some days before death, the body of the patient appears to enter into decomposition; it exhales a putrid odour; sometimes the surface of the skin is covered with petechiæ, and shreds of the teguments are detached. The pulse becomes smaller and more frequent, and the patient expires in a paroxysm of delirium, in slight convulsions, or in a swoon.

Incomplete abstinence produces effects differing only in their less intensity from those of complete abstinence. Thus it causes repose of the stomach, diminishes the labour of digestion, and renders this function easier, more rapid, and more complete; gives more time for the exercise of the other functions, augments absorption in the parenchymata, allows the lymphatics time to remove from the digestive mucous surfaces the products of previous imperfect digestion and of all the altered or increased secretions designated by the term *saburræ*, restores the appetite, and causes the removal of many of the matters secreted, effused, or attracted into the irritated tissues.

Abstinence from particular articles of food produces effects dependent upon the kind of food abstained from, those used, and the other circumstances to which allusion has already been made. (LONDE. *Dict. de Méd. Prat.* I. 109.)

The effects of abstinence are liable to be variously modified, by a number of circumstances which have already been enumerated. Abstinence is frequently complicated with disease, and it is extremely difficult, often, to distinguish the phenomena arising from the former from those which are the result of the latter. To render the preceding picture of the phenomena caused by abstinence more complete, we shall quote a few cases.

The following were the effects of inanition, observed by Dr. CURRIE, in a case of obstructed œsophagus, apparently from a tumour. We omit the details which are irrelevant to our present object.

The patient was a gentleman, 66 years of age. The dysphagia, at first slight, continued gradually to get worse for ten or twelve months. On the 17th of October, a sudden increase of the obstruction came on, and from that period he was able to swallow a table-spoonful only of liquid at a time, and at long intervals. It was with difficulty that he got down seven or eight spoonsful of strong soup in a day, and this quantity gradually diminished. On the 1st of November, the obstruction was complete, and the following plan was adopted for the prolongation of life. Each morning, at eight o'clock, he had a clyster, consisting of eight ounces of broth, two yolks of egg, and forty drops of laudanum; this was repeated at three, P. M., and again at nine, P. M., but with thrice the quantity of laudanum. Previously to the evening draught, a bath, of the temperature of 96° Fah., was used, consisting of one-fourth part of milk, and three-fourths of water. In a few days the clysters were augmented in quantity, and eight ounces of wine were added, with an increased dose of laudanum. This plan was continued until the 2d of December, when the rectum no longer retaining the clysters, their employment was relinquished. Notwithstanding these measures, the emaciation was rapid. In health, the patient had weighed 240 lbs.; on the 20th of November he weighed 154 lbs., and on the 25th 149 lbs. only. About the 25th or 26th of October, the urine was reduced to a few ounces in the twenty-four hours, extremely high coloured, and almost intolerably pungent. In a few days, however, urine was discharged of a natural appearance and in the usual quantity, from 24 oz. to 36 oz. in the twenty-four hours. The patient had in general a stool three or four times a week. The substance of these stools was solid, homogeneous, lighter than common, and of the usual fetor. The animal temperament was natural, and nearly uniform from first to last. During the whole month of November, the pulse was natural; on the 1st of December it became small and frequent; and still more frequent, though stronger, after the delirium commenced; and at that time the symptoms nearly resembled those of the last stage of fever, when it terminates fatally. "During this delirium, a perpetual and indistinct muttering occurred, with

great restlessness and agitation; the surface and extremities were sometimes of a burning heat, sometimes clammy and cold. The eyes lost their common direction, the axis of each being turned towards the nose. In this state, however, the sensibility of the retina was not impaired, but rather increased, for he screamed out on the light of the window being admitted, to which before he had been accustomed. At this time, also, the sense of touch seemed more than usually acute, for he appeared disturbed with every accidental breath of air. The delirium and the derangement of vision commenced nearly together, but we observed the derangement of vision first. On the 1st of December, he complained that he sometimes saw double; but it was not till the succeeding day that any considerable incoherence of mind was observed. The pulse became feeble and irregular on the fourth; the respiration, which had been singularly undisturbed, became laborious; the extremities grew cold; and in ninety-six hours after all means of nutrition, as well as all medicine, had been abandoned, he ceased to breathe." The patient complained very little of hunger, and this sensation was relieved by the clysters. He suffered during the first days of his abstinence from thirst, but not subsequently, and he declared that his thirst was always removed by the tepid bath. His spirits were even and his nights good. (*Med. Reports*, 4 ed. I. 304.)

The following case is that of a farmer, thirty years of age, of violent passions, small stature, dark chestnut hair, great muscular strength, brutal, cowardly, of great moral insensibility; who, in a fit of jealousy, murdered his wife, and, subsequently, in a moment of anger, one of his fellow prisoners, who had irritated him. Confined in the prison of Toulouse, he manifested, about the 15th or 20th of April, a disposition to starve himself to death; entertaining the belief, that if he died upon the scaffold his property would be confiscated and his children left in poverty. He obstinately refused, from this period, all food, solid or liquid, and would not answer any questions, except occasionally by motions of his head. Seeing that he persisted in his refusal to take food, various attempts were made, but without success, to compel him to do so, and to introduce through a tube, nutritious matters into his stomach. The urine which he passed during the first days, exhaled a fetid odour, and produced a burning in the urethra. On the 25th of April he drank his urine. At this period, emaciation began to be perceived. The breath became fetid, the urine more abundant and high coloured. The pulsations of the radial artery were scarcely perceptible. On the 28th of April he walked an hour in the court, and drank a little water. Of the daily persuasions to induce him to eat, he took no notice, not even by a sign with his head. He passed whole hours, lying on his straw bed, upon one side, his knees bent. The 29th he experienced trembling in his whole body; he drank a little water. The 30th he drank two cups of water. The 1st of May he spoke, but it was difficult to comprehend what he said. The 2d he wallowed in the kennel in the court. The morning of the 3d he drank some water, and urinated in his bed. At noon he again drank some water, and towards midnight took two spoonsful of broth, and passed some carbonized excrements. The morning of the 5th he went to the well, seized the bucket, and gorged himself with water, until the liquid flowed back through his mouth and nostrils. Towards midnight he drank a little broth and a few drops of wine; he endeavoured, but in vain, to eat a little bread. The 7th he drank his urine, took his soup like the other prisoners, and put a quarter of a spoonful of it in his mouth, but it is not known whether he swallowed it or not. Up to the 25th there was but slight change in his condition; the emaciation made rapid progress. His body exhaled a *peculiar* fetid odour. His face, at this period, was dejected, his expression savage; his cheeks flushed and somewhat violet; his eyes, constantly shut, were brilliant, but hollow. He remained almost constantly in a recumbent position, with his limbs drawn up. At times he was agitated, struck himself, and even wounded himself with his nails; he would not answer any questions. This day, however, he spoke much, complained that he was beset by people, who visited only for the purpose of deriding him. From the 25th of May to the 8th of June, there was little variation in the symptoms. He often drank water, and even plentifully; the 28th of May he drank eight glasses of water in succession, saying that he had not drunk any for fifteen days, and that he could drink more if he wished; and added that he could eat even, if he desired it. He complained to the physician that he felt a burning in the epigastric region, which was relieved by drinking a little water. He often drank his urine, manifested anger, and broke the articles he found at his door. From time to time he walked in the court,

stood in the sun, and seldom spoke. The 30th of May his pulse was only 37; and the temperature of his body never more than 75° Fah.; he passed, at distant intervals, some carbonized excrements, and sometimes experienced pain in the belly, and convulsive tremors after having drunk. The 8th of June his pulse in the morning rose to 108; in the afternoon it fell to 89. The 9th he began to utter plaintive cries; his sensibility had considerably diminished; deglutition had become impossible, and liquids were rejected by the nostrils and mixed with purulent matters. The emaciation was extreme. The pulsations of the aorta could be perceived through the abdominal parietes. He asked for water, but would not converse; abused the priest who offered him religious consolation. From this period to the morning of the 17th of June, the day of his death, no remarkable symptom was manifested. He vomited some mouthsful of green bile; could not swallow; had slight hiccup, but this symptom did not persist. Interrogated respecting his sufferings, he replied that he did not experience any. Gangrenous eschars and ulcerations formed upon those points of his body upon which he rested. From the 14th his pulse became insensible. The ulcerated surfaces speedily dried, and, notwithstanding the frightful state into which his sufferings had plunged him, it was not until the last day of his life that he complained of experiencing pain over his whole body, and of a feeling of cold. Convulsions terminated this long agony. (*Gazette Médicale de Paris.* II. 390.) The appearances on dissection will be noticed in the subsequent section.

A case of suicide by inanition, analogous to the preceding, was communicated to the Academy of Medicine, at their meeting of the 30th of August, 1831, by Dr. Serrurier. The subject was a musician, who, from the moment he announced, with perfect nonchalance, his determination to starve himself, until his death, a period of sixty days, took occasionally only a few mouthsful of water and orgeat syrup. There was scarcely any sensible emaciation during the first fifteen days. At first, feces were discharged, but subsequently they were suppressed. The urine, at first copious, became scanty, dark, and flocculent, with a deposit of a phosphoric odour. During the last twenty days of his life, there was a cadaveric odour of the whole body; diarrhœa with fetid discharges; putrid breath, painful trismus, acute pain at the epigastrium; rapid emaciation; deformity of the chest, which became contracted and projecting; shoulders narrowed, allowing the vertebræ to project; the abdominal parietes flaccid; the pelvis seemed to form an immense cavity. The skin was covered with petechiæ and detached in shreds. (*Archives Générales.* XXVII. 130.)

The animals deprived of food by M. Collard de Martigny, exhibited the following physiological phenomena: during the first few days the animal was agitated; when any one approached, it showed, by cries, a desire for food; walked up and down its cage, sought food, and the means of escaping. After the first week, the animal experienced periods of the most violent agitation: this was manifested by sharp and repeated cries, especially at the commencement and close of day; nevertheless, it almost constantly remained in a recumbent position, and seemed to dread motion. On the third week, a period of real madness supervened; the animal gnawed, incessantly, the bars of its cage, its eye was burning, its aspect sometimes threatening, its mouth half open, its tongue red and dry. Towards the twentieth day it became prostrate, with occasional short instants of agitation; the emaciation became extreme; the eye dull, dejected; the animal rested lying on its side; when called to, it raised its head; its movements were very slow; it could scarcely stand; its respiration was painful. Later, these phenomena were augmented; the animal could no longer raise itself; it stretched out its neck to breathe; the animal temperature diminished, especially in the extremities: finally, reduced to the last degree of marasmus, the animal remained constantly lying, the neck stretched out and rigid, and fell down if placed upon its feet; its respiration was by jerks, and interrupted; it lapped its tongue in the water presented to it, but could not swallow; refused bread; and death closed the scene. Such, with slight variations, were the successive perturbations of the functions produced by abstinence in dogs.

§ 3. *Organic lesions exhibited on dissection.* The descriptions of these alterations given by most writers, are manifestly drawn from their imaginations, and in accordance with preconceived notions, rather than derived from actual observations. Instances of death from inanition are, it is true, by no means rare; yet it is so recently, only, that a due importance has been attached to pathological anatomy, that but few well-conducted post-mortem examinations are recorded; hence we do not possess a

sufficient number of carefully-observed facts derived from that source, to enable us to fix with precision the organic alterations produced by abstinence. The zeal with which the science is at present cultivated, gives the assurance that this point will not long remain unelucidated; in the mean time, all that can be done, is to expose the principal observations that have thus far been made.

The most interesting, as well as recent case, and the one in which the post-mortem examination appears to have been made with the most care, is that of the prisoner of Toulouse, already noticed. The following were the appearances observed in this subject, on examination thirty hours after death; as related by Dr. Desbarreaux-Bernard. *Habitude.* Marasmus, complete; cheek bones and zygomatic arches very prominent; eyes exceedingly hollow; nose thin. *Head.* Very marked development of the posterior part of the cranium, relatively to the smallness of the anterior parts; very decided protuberances above and behind the ear. Remarkable thickness of all the bones of the cranium; dura mater normal; old adhesion to the extent of two inches between this membrane and the brain, along the superior longitudinal sinus. Cerebral arachnoid transparent, but firmer than common, very slightly lubricated. On raising up the membranes, the brain appeared paler than ordinary; no serum in the ventricles; the cortical substance of ordinary density; the white substance, examined in different points of the brain, presented a very remarkable density and consistence; it was firm and elastic, especially towards the base of the cranium. Cerebellum small, relatively to the size of the cerebrum; its substance firm, and of the same density as the latter: this induration extended to the medulla oblongata, the cords of which could be separated with the greatest facility. *Thorax.* Heart pale, of the natural size, flabby, soft, easily torn. Right lung crepitant, normal colour; a slight pneumonic engorgement at the lower part of its posterior border. Left lung not crepitant. The larger branches of the bronchi studded with red spots; the smaller branches redder, and having some œdematous points. *Abdomen. Digestive passages.* Œsophagus contracted, very slim, mucous membrane firm. Stomach ordinary capacity, containing about a glass of greenish liquid; mucous membrane exceedingly firm, very adherent in the great cul-de-sac; could not be separated except in very small shreds; softer and thinner near the pylorus. Small intestines slightly contracted, of a slight brown colour; the inferior extremity of the ileon alone, was of a very marked reddish-brown colour. The intestinal parietes sensibly thinner than normal. The mucous membrane of the superior portion of the intestine, of a yellow colour, and perfectly healthy; in the lower portion, it was *red, softened*, and *highly injected.* Valvuli conniventes very apparent. Large intestine of natural size, slightly dilated, its transverse and descending portion empty, the remaining portion filled with hardened fecal matters. The direction of the transverse colon was oblique from right to left, and above downwards; its mucous membrane healthy, except in the transverse colon, where it was softened. *Omenta,* reduced to their serous membrane, traversed by blood-vessels. *Mesentery* without adipose tissue, contained some enlarged ganglions. *Biliary apparatus.* Liver ordinary volume, brick-coloured, very granulated, density greater than normal. Gall bladder much distended with black thick bile, containing granules. *Spleen* very small, almost round, about two inches in diameter; its tissue healthy, but very dense and firm. *Urinary organs.* Kidneys small, healthy; their substance red, firm, and compact. Bladder healthy, dilated, contained a tumbler of very red urine. Its mucous membrane of a bright white. *Muscular system.* The muscles, though extremely attenuated, were of a decided red colour. On sawing through the femur, the medullary canal of that bone was found filled with marrow in a natural state: this was the only part of the body in which adipose tissue was found. (*Gaz. Med.* II. 391.)

It cannot be positively pronounced, on account of the existing paucity of well-observed facts, whether all the phenomena observed in the preceding case resulted solely from inanition; it is probable, however, that most of them did.

It is almost unnecessary to observe, that the cadaveric phenomena must be modified by all the various circumstances which we have enumerated as influencing the physiological effects of abstinence; and that in most instances, there will be combined with the effects of abstinence, those arising from other influences. It is by comparing a great number of cases together, that those which are the effect of abstinence can be positively determined.

For some of our most positive knowledge respecting the alterations produced in the organism by inanition, we are

indebted to M. Collard de Martigny. The experiments of this physiologist were, however, made upon dogs and rabbits, and although the organization of these animals may be very similar to that of man, it is not identical, and the results are of course less conclusive for our purpose, than if obtained from the latter. The observations of M. De Martigny, must, nevertheless, be admitted to shed important light upon the subject, and it is proper, therefore, to notice here his results. They are as follow:—

"The sole *constant* alterations, demonstrated by post-mortem examination, in the tissues and parenchymata of the organs of animals that have died from starvation, are:—an excessive emaciation, the almost entire vacuity of the whole sanguineous system, paleness of the mucous membranes, general whiteness of the tissues, and depression of the cornea. The emaciation is greater in the muscles of the thorax than in those of the limbs and neck: the atrophy of the spleen and pancreas is also greater than that of the other viscera. These alterations are sometimes complicated with a more or less slight local inflammation. Prolonged abstinence does not produce ulceration of the cornea. The slower the animal dies, the greater are the organic alterations caused by abstinence. The secretion of bile appears to suffer no diminution, whilst the quantity of all the other fluids of the body daily becomes less. The blood progressively diminishes in quantity, during the whole duration of abstinence. Towards the termination of life, this fluid penetrates only a portion of the tissues, so that the circulatory circle is contracted in consequence of the diminution of the quantity of blood. The proportion of the solid constituents of the blood, increases in proportion as the quantity of this fluid is lessened. At the same time, the proportion of the fibrine in the clot greatly diminishes, and that of the albumen increases. The lymphatic system does not always contain lymph; whilst the process of chylification is active, it contains none. Towards the termination of the process of chylification, and especially after it has terminated, lymph is *always* found in a part or in almost the whole of the lymphatic system. During about the first third of the period of abstinence, the quantity of the lymph is very considerable, and it increases, the longer the animal fasts; whilst during the other two thirds of the time, its quantity gradually diminishes. Some hours before death there is but little lymph contained in the thoracic canal. The more slowly the lymphatic vessels of the different portions of the body are filled with lymph, the slower they empty themselves."—"During the period of its augmentation in quantity, the lymph gradually becomes richer in colouring matter, in coagulum and fibrine. During the remainder of the period of abstinence, the lymph becomes less and less coagulable, coloured, and fibrinous, the nearer death approaches." (*Journ. de Phys.* VIII. 186–9.)

M. De Martigny asserts that the evidences of local inflammation designated in some of the examinations after death from abstinence, were a *complication*, and are, at any rate, of rare occurrence; since out of eighteen animals opened and examined with the most scrupulous accuracy, he only met with three examples of this nature; and two of these had, he says, an evident origin. He considers, therefore, the *disease* produced by abstinence prolonged until death, to be the result—1st, of the alteration of the solids; 2d, and chiefly, of alterations of the blood, which are the essential cause of the first.

§ 4. *The treatment of the morbid effects of Abstinence* is sufficiently obvious, and consists principally in the cautious administration of nourishment. The full indulgence of the appetite might be attended with speedily fatal consequences. The food selected should be mild, nutritious, easily digestible, and ought to be allowed in small quantities only at a time. Solid food and milk should be, at first, avoided. Animal broths, and the farinaceous substances, &c., are to be preferred; and the quantity allowed is to be gradually increased, as the patient becomes able to bear it. One of the consequences of the diminution in the energy of the functions is, a lessening of the animal temperature; the warmth of the body should therefore be promoted by warm applications, and frictions. The following fact is related by Dr. Marshall Hall, in evidence of the efficacy of warmth in these cases. "Some white mice had been neglected, and passed upwards of forty hours without food; they had become torpid and cold; by being held in a warm hand, they were perfectly restored to life and activity, before a mouthful of food had been administered." Frictions are also useful in assisting the powers of the circulation, which are greatly enfeebled. Internal stimulants are rarely required; and should never be administered but with extreme caution, and in very moderate doses; and it may be advisable to conjoin with them small doses of an anodyne. The bowels are to be kept open

by mild enemata, as of barley-water. These measures will usually succeed in relieving the effects of simple abstinence, when they admit of a cure. The treatment of the effects of abstinence conjoined with other causes, will be elsewhere considered.

§ 5. *Abstinence as a remedial measure.* The utility of abstinence in the treatment of diseases, especially acute ones, has been recognized ever since the earliest periods of our science. Hippocrates was fully sensible of its advantages; Celsus, Heraclides, and Cœlius Aurelianus, considered it as among the most powerful of our remedial measures; Sydenham asserts that he often cured fevers in their commencement, merely by directing diluents, and prohibiting every kind of food; and the celebrated French physician, Fernel, is said to have cured, by diet alone, very violent diseases, which had resisted all other remedies. But, independent of all authority, daily experience demonstrates the utility of this measure; and nature seems, in some cases, to have made it a condition of the resolution of disease. Loss of appetite, disgust of food, mark the commencement of most acute affections, and compel the patient to abstinence. The mode in which this powerful therapeutic agent acts is perfectly intelligible.

Life is a series of actions of composition and decomposition. The first are effected by digestion, chylification, hematosis, and assimilation; the last by pulmonary, intestinal and cutaneous exhalations, by the various secretions and excretions, by the cerebral actions, &c. When these actions are in relation, the forces and embonpoint of the individual are preserved, and this constitutes his normal or physiological condition. The losses which the organism suffers, being repaired by equivalent supplies, there is an equilibrium. But if, from any cause whatever, the system is deprived of its means of reparation, the functions of decomposition continuing, the blood, no longer supplied by the digestive function, ceases to convey into the organs the materials for their support. On the other hand, as interstitial absorption continues, the empty blood-vessels are filled by fluids detracted from the different viscera. The greater the vacuity of the vessels, that is, the longer and more rigorous the abstinence is, the more active and energetic absorption becomes; hence there is no difficulty in understanding the facility with which engorgements are dissipated under the influence of this absorbent action. Two important effects, each equally intelligible, result from abstinence: the first may be termed negative, and consists in the stoppage of the supply of new means of reparation; that is, in a state of disease, new means of congestion and irritation are not supplied to the affected organ through the means of digestion; in this respect its effects are similar to those of blood-letting, only slower. The second may be termed active, since the function whose office it is to produce resolution of disease, is increased in activity. (Rostan. *Dict. de Méd.* I. 295.)

The advantage of abstinence as a prophylactic measure, in countries subject to pestilential diseases, has been strongly insisted upon by the late Dr. Edward Miller, of New-York. "Not only the caution of individuals," says he, "but the habits of nations, may be distinguished in the comparative exemption from diseases, which they derive from abstemiousness. The French and Spaniards in the West Indies, and in other warm climates, avoiding the use of ardent liquors, and retaining their usual habits of thin and spare diet, are observed remarkably to escape the dangers incidental to such situations; while the British, carrying with them, wherever they go, not only their plethoric habits, but likewise their national predilection for a gross and stimulating plan of living, suffer all the havoc of those baneful countries. From every tropical region similar examples might be brought; and wherever experience has enforced accommodation to the inclemency of a hot climate, we observe people relinquishing all such excesses and grossnesses of diet as can only be safely indulged in the higher latitudes." (See *Acclimatement.*)

In all acute diseases abstinence is a powerful, not to say indispensable, remedial measure; and it should be severe in proportion to the acuteness, violence, and recentness of the disease. Absolute abstinence is, however, never required, except where the stomach is so phlogosed as to reject even water given in the smallest quantities. We must be permitted here to quote the following just observation by Marshall Hall. "It is impossible to refer to the subject of the use of abstinence as a remedy in disorders or diseases of the stomach, without recalling to our minds the services which M. Broussais has rendered to this department of medicine: the *diète absolue*, or extreme abstinence, recommended in gastritis, by that author, is, assuredly, a far more natural and appropriate remedy, than the mistaken administra-

tion of drastic purgatives, too much employed in this country." (*Cyclop. Pract. Med.* I. 21.)

In chronic diseases, abstinence is not so necessary as in acute; and, although in the former it is also one of the most powerful remedial means, yet too long a time is required for their cure to admit of absolute abstinence, since the patient might die of inanition before their resolution. Moreover, in some chronic affections hunger is imperious, and the patient feels a real necessity for reparation.

Abstinence, by its power of exciting the activity of the absorbent system, is a powerful resolvent of engorgements, and is equally efficacious in producing the removal of various effusions. It is said to have also been employed with success by Valsalva, in the cure of aneurisms. (Morgagni. Book I. Ep. 16. § 30.)

But though abstinence is so valuable a remedial agent, there are, of course, limits to its employment. In very young children, it is extremely necessary to watch its effects, since at this age it may speedily prove fatal. The most serious cerebral symptoms are very frequently produced in them from prolonged low diet, and most of the symptoms of inflammation of the membranes of the brain may result from privation of food. Piorry quotes some instances of this. Fr. Hoffman has insisted much upon the dangers of abstinence, (*De inediæ noxâ atque utilitate*); but he has greatly exaggerated them, and has unquestionably attributed to abstinence, effects which are ascribable to other causes. Thus, when he attributes to abstinence the malignant diseases which occur in besieged cities, it is evident that he takes into consideration but one of the causes of these diseases; and, secondly, that the individuals were, at the time, in health. Barras, Piorry, and Cafort, have also exposed the dangers of abstinence, but it appears to us that their statements also are exaggerated. "I am not ignorant," observes M. Rostan, "that attempts have recently been made to prove, by observations, that abstinence is most frequently injurious, and that food favours the cure of diseases; but it is evident to me that, in the first case, abstinence could not prevent patients from dying, which, unfortunately, too frequently happens; whilst, in the second, alimentation could not prevent their getting well, which is also a frequent event."

It would extend this article far beyond our limits to indicate the various diseases in which abstinence is useful, or to point out all the rules which should restrict its employment; this will find a more appropriate place in the articles on each of these diseases: all that we proposed in the present section, was to point out the general propositions relative to abstinence as a therapeutic agent.

In the present article we have considered only simple abstinence; its effects when combined with other morbid influences, will be treated of under the head of *Famine;* and in the article *Starvation*, its medico-legal relations will be noticed.

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I. Hays.

ACACIA. *Acacie*, Fr., Germ.

Sex. Syst. Polygamia Monœcia.—*Nat. Ord.* Mimoseæ.

Gen. Ch. HERMAPHRODITE. *Calyx* five-toothed. *Corolla* five-cleft, or of five petals. *Stamens* 4-100. *Pistil* one. *Legume* bivalve. MALE *Calyx* five-toothed. *Corolla* five-cleft, or of five petals. *Stamens* 4-100. WILLD.

This genus was separated from the Mimosa of Linnæus by Willdenow, who very appropriately conferred upon it the title employed by the ancients to designate one of its most important species—the gum-tree of Egypt and Arabia. The medicinal species of Acacia are prickly or thorny trees or shrubs, with alternate doubly-pinnate leaves, of which the leaflets are usually very minute. Their flowers are yellowish, and collected in axillary peduncled heads, or elongated spikes. The fruit is a dry leguminous bivalvular pod, of various form in different species. The bark and unripe pods contain astringent matter, and are said to be sometimes employed, in the countries where the plants abound, for tanning leather. The wood of one species—the *A. catechu*—furnishes the extract well known by the name of *catechu*. But the most important product of the *Acacias* is *gum Arabic*, which is afforded by numerous species growing in Arabia and Africa. The gum exudes in dry weather, and hardens upon the bark, whence it is removed by the natives. (See *Gum Arabic*.)

1. *A. Arabica*, Willd.—*A. Nilotica*, Delile.—*A. vera*, Vesling.—*Mimosa Nilotica*, Linn.—*Sp. Ch.* "Prickles twin, straight; pinnæ in 4-6 pairs; leaflets in 10-20 pairs, oblong-linear; a gland between the lowest pair of pinnæ, and often between the uppermost pair; heads aggregated, axillary; legumes compressed, moniliform." *Hayne.* This species and the *A. vera* were both included in the *Mimosa Nilotica* of Linnæus. The *A. Arabica* is, when full grown, a considerable tree, with a stem somewhat crooked, covered with a rough brownish bark, and divided into numerous branches. It grows in Upper and Lower Egypt, and other parts of Africa, in Arabia, and in the East Indies. The astringent substance known by the name of *Acaciæ veræ succus*, and formerly used in Europe in the treatment of diarrhœa and dysentery, was procured from the unripe fruit of this species and of the *A. vera*, by expressing the juice, and evaporating it to the consistence of an extract. The fruit itself, which consists of a long flat ash-gray pod, contracted at certain intervals so as to present a succession of circular portions, each containing one seed, is used in India for tanning and dyeing black. Considerable quantities of it have been imported into France under the name of *Bablah*. It abounds in tannin and gallic acid, and is said to be superior even to galls for dyeing. *Gum Arabic* is collected from the *A. Arabica*, in various parts of Africa, Arabia, and Hindostan, but, according to Ehrenberg, not in Egypt, as the peasants are more profitably occupied in agriculture in those districts where it flourishes. Roxburgh states, that in Hindostan the gum is used by the natives as food, mixed with the cake which remains after the expression of the oil of sesamum.

2. *A. Catechu*, Willd.—*Mimosa Catechu*, Linn.—*Sp. Ch.* "Prickles twin, stipular, uncinate; leaves bipinnate with 8-16 pairs of pinnæ; leaflets in many pairs, pubescent; glands of the petiole two or three, one below the lowest pair of pinnæ, and one between the uppermost pair, or each of the two uppermost pairs; spikes axillary, twin, or in threes, ventricose-cylindrical." *Hayne.* According to Mr. Kerr, this species of Acacia seldom exceeds twelve feet in height. Others represent it as a lofty and elegant tree. It probably varies in size with the circumstances of soil and climate. Its trunk is very thick in proportion to its height, and is covered with a rough, brown bark, which is internally red, and has an astringent bitterish taste. The branches are very numerous, and the younger armed with prickles. The leaves are from six to twelve inches long, with thirty or forty pairs of minute leaflets upon each of the pinnæ, of which from fifteen to thirty pairs, according to Kerr, are arranged along the common footstalk. The flowers are in close spikes, four or five inches long, and placed two or three together in the axils of the leaves. The fruit is a flat, straight, smooth pod, pointed at both ends, of a light brown colour, four or five inches long, and containing five or six roundish compressed seeds. The tree grows in various mountainous districts of Hindostan, and is especially abundant in the provinces of Bahar and Canara. Catechu is obtained from it by evaporating a decoction of the wood, to which the bark and unripe fruit are sometimes added. (See *Catechu*.)

3. *A. Ehrenbergiana*, Hayne.—*Sp. Ch.* "Prickles stipular, twin, straight; leaflets of the pinnæ in 5-9 pairs, linear-oblong, tomentose; a gland between the pinnæ; heads axillary, aggregate, globose." *Hayne.* This is a shrub from six to eight feet

high, inhabiting the Lybian desert, and the deserts of Nubia and Dongola, where it was seen by Ehrenberg, in whose honour it has been named. According to this author, it is called *Samle* (*Zamlay*) by the Bedouins, who collect gum from it for sale to the merchants.

4. *A. gummifera*, Willd.—*Sp. Ch.* "Prickles stipular, twin, straight; leaflets of the pinnæ in 5-7 pairs, linear-oblong, smooth; a gland between the pinnæ; spikes axillary, oblong; legumes compressed, somewhat moniliform, grayish, tomentose." *Hayne.* This plant was observed by Broussonet, in the neighbourhood of Mogador, in Morocco; and the description of the species given by Willdenow in his edition of the Sp. Plant. was drawn up from a specimen transmitted to him by that traveller. Forskal speaks of an *A. gummifera* as a native of Arabia; and Delile, referring to the same plant, mentions it as growing in Upper Egypt; but whether it is identical with the *A. gummifera* of Broussonet, we have no means of determining. It is probable that a portion of the *Barbary gum* is procured from this species.

5. *A. Senegal*, Willd.—*Mimosa Senegal*, Linn.—*Sp. Ch.* "Prickles stipular, straight, very short; pinnæ in 5-8 pairs; leaflets in 15-18 pairs, oblong-linear, obtuse; petioles and branches smooth; glands between all the pinnæ, sessile; spikes axillary, solitary, slender." *Decandolle.* In Linnæus's description, three prickles are mentioned, of which the middle is recurved; but this is not always present, and is in fact an abortive branch or thorn. The *A. Senegal* is a tree from fifteen to twenty feet high, and is easily distinguished at a glance from most of the other species by the whiteness of its bark. It is abundant in the regions about the rivers Senegal and Gambia, and forms a large portion of the Acacia forests which grow in the country back of Portendic. It is said also to grow in Egypt and Arabia. It furnishes much of that commercial variety of gum called *Gum Senegal.*

6. *A. Seyal*, Delile.—*Sp. Ch.* "Prickles twin, straight; pinnæ in 2-4 pairs; leaflets in 8-12 pairs, oblong-linear, smooth; a gland between the two upper pairs of pinnæ; heads axillary, aggregate; legumes compressed, linear-falciform, somewhat torose, acuminate, costato-striate." *Hayne.* This is a small tree, from fifteen to twenty feet high, growing in Upper Egypt, Nubia, Dongola, and the Lybian desert, and called by the natives *Seyal*, which has been adopted as the botanical title. It is, according to Ehrenberg and Hemprich, among the trees from which gum is actually collected.

7. *A. tortilis*, Hayne.—*Mimosa tortilis*, Forskal.—*Sp. Ch.* "Prickles twin, straight, the abortive ones recurved; pinnæ in 2-5 pairs; leaflets in 5-11 pairs, oblong-linear; a gland on the petiole; heads axillary, solitary; legumes compressed, linear, striated in the form of veins, variously contorted and flexuose, smooth." *Hayne.* The *A. tortilis*, named from the peculiar character of its pods, is a large tree, attaining the height of forty or even sixty feet, with a trunk from two to four feet in diameter. It is a native of Arabia Felix, where it was seen by Forskal; and of the Lybian desert, Nubia, and Dongola, where, according to Ehrenberg, gum is collected from it by the Bedouin Arabs.

7. *A. vera*, Willd.—*Mimosa Nilotica*, Linn.—*Sp. Ch.* "Prickles twin, nearly straight; pinnæ in two pairs; leaflets in 8–10 pairs, oblong-linear; a gland between each pair of pinnæ; heads axillary, aggregate; legumes compressed-moniliform." *Hayne.* This is not the *A. Nilotica* of Delile, described by some authors as the *A. vera.* The former is identical with the *A. Arabica* of Willdenow, and was confounded with the present species in the *Mimosa Nilotica* of Linnæus. The *A. vera* attains, in favourable situations, the magnitude of a considerable tree, but is frequently nothing more than a shrub. Its trunk is erect, and divides above into very numerous prickly branches, of which the younger are externally of a reddish-brown or purplish colour. The leaves consist of two pairs of pinnæ upon a common footstalk, with from eight to ten pairs of leaflets on each pinnæ. The prickles are from one quarter to half an inch long, and always shorter than the leaves, near the base of which they are inserted. The flowers are in spherical heads, which are supported upon slender peduncles, and collected to the number of from two to five in the axils of the leaves. The fruit is a flat, leguminous, bivalvular pod, several inches long, divided by regularly recurring contractions into numerous circular portions, like a string of flattened beads, each portion containing one seed. This species grows through the interior of Africa, from Senegal to Egypt. It is said, in connexion with the *A. Senegal*, to form the greater part of the Acacia forests, from which the gum Senegal is gathered. It is not, however, as stated by some authors, a native of the Cape of Good Hope. The Acacia growing in this part of Africa, which was considered by Sparrman and Thunberg as

the *Mimosa Nilotica* of Linn., has been ascertained to be a distinct species, and has received the name of *A. Karroo.* Besides gum, the *A. vera* is said to have formerly furnished, from its unripe fruit, by expression and inspissation, the extract before alluded to, under the name of *acaciæ veræ succus*, as a product of the *A. Arabica.*

It is probable that other species of Acacia, not yet known to botanists, contribute to furnish the gum Arabic of commerce. There are, also, many known species, from which gum exudes in considerable quantities, without being collected as an object of trade. Such is the *A. Karroo* of the Cape of Good Hope, the gum of which is said to be sometimes employed by the natives for food in times of scarcity, and to be used at the Cape as a medicine. Such are, also, the *A. decurrens* and *A. floribunda*, which grow in New Holland, and afford a product analogous to gum Arabic. The *A. Lebbek*, a native of Egypt, is said by some authors to be among the gum-bearing species; but this is denied by Ehrenberg. M. Busseuil reports that there are several Acacias in Chili, which yield a gum employed by the inhabitants in the place of gum Arabic.

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GEO. B. WOOD.

ACALYPHA. THREE-SEEDED MERCURY. *Ricinelle*, Fr.; *Brennkraut*, Germ.

Sex. syst. Monœcia monodelphia. *Nat. Ord.* Euphorbiaceæ.

Gen. Ch. MALE, *Calyx* 3-4 leaved, *Corolla* none. *Stamens* 8-16. FEMALE, *Calyx* 3 leaved, *Corolla* none. *Styles* 3. *Capsule* 3 coccous, 3 celled, 1 seeded. *Lindley.*

This genus was established by Linnæus to contain several plants, resembling the nettles as its name signifies. Many of the species are possessed of medical properties.

1. *A. Betulina.* Birch-leaved Acalypha. *Sinnee Elley* Tamul.

Sp. Ch. Fruticose; leaves ovate, acute, serrate. Female involucres cordate, crenate. *Retz.*

This plant is a native of many parts of India; it commonly rises to the height of six feet, with round branches, and a light brown bark. The leaves, which are the part used in medicine, are about two inches long, and an inch and a half broad, acuminate and deeply serrate, and have a very pleasant and aromatic taste and smell. Ainslie states that they are much esteemed by the Hindoo practitioners, as a stomachic in dyspepsia and cholera, as well as for their attenuant and alterative qualities. The dose is half a tea-cup full of an infusion of them, given twice a day.

2. *A. Indica.* Indian Acalypha. *Koopamaynie.* Tamul.

Sp. Ch. Spikes axillary; male above, female below. *Involucres* smoothish, serrated. *Leaves* ovate, acuminate serrate, cuneate at base. *Lindley.*

This is an annual plant, found in many parts of India, seldom attaining more than a foot and a half in height. It is much used by the Hindoos as an anthelmintic: a powder of the dry leaves, or a decoction of them with the addition of a little garlic, is given to children for this purpose. The juice of the leaves and young shoots is also rubbed on the tongues of infants, to produce vomiting. According to Rheede, (Hort. Malabar, x. 161, T. 81,) the root is used as a purgative on the Malabar coast, and a decoction of it and of the leaves will relieve pain in the ear, if poured into the meatus.

3. *A. Virginica.* Mercury weed.

Sp. char. Female flowers at base of male spike. *Involucrum* ovate acuminate, toothed. *Leaves* oblong, lanceolate, remotely toothed. *Lindley.*

This ordinary looking plant, which is found abundantly in most parts of the United States, in cultivated grounds, roadsides, &c., is also said to be possessed of remedial properties. Elliot states that it has been found useful as an expectorant and diuretic, in asthma and dropsies. It is also employed by empirics for many other purposes.

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R. E. GRIFFITH.

ACARDIA. (From α priv. and χαρδια, the heart.) Without heart; a vice of formation which occurs in some fœtuses. See *Heart, vices of formation of.* I. H.

ACATAPOSIS. (From α priv. and χαταποσις, deglutition.) Incapacity of swallowing. VOGEL has applied this term to diseases in which there is difficulty of deglutition. I. H.

ACATASTATIC. (From α priv. and χαδιστημι, to determine.) An epithet given

to fevers the paroxysms and succession of symptoms of which are irregular. I. H.

ACCELERATOR. (From *accelerare*, to hasten or propel.) This term is applied to a muscle of the penis, (*accelerator urinæ*,) the office of which is to propel the urine and semen forwards. I. H.

ACCESS. *Accessus*, Lat. (From *accedere*, to approach.) This word, especially by French writers, by whom it is principally employed, is used in somewhat different significations. Thus, by some, it is employed as synonymous with paroxysm and attack, (q. v.) and by others, to indicate a series of morbid phenomena which come on and cease periodically, as those of intermittent or remittent fever. It is to this last signification that the best French lexicographers would restrict the use of the term. I. H.

ACCESSORY. That which has a dependence on, or is secondary to, some other. In *anatomy*, it is applied to certain muscles, ligaments, nerves, &c., which are joined to other similar parts, and assist in their functions. In *physiology*, this term is given to certain phenomena which result from others which are primary or essential; such are the effects of the contraction of the diaphragm, in respiration, upon the abdominal viscera, the circulation, &c. In *pathology*, it is employed to designate certain phenomena which follow others without being a necessary consequence of them; as the swelling in the arm-pit, resulting from whitlow, or injury of the hand; &c. Finally, it is applied to several sciences, more or less intimately connected with medicine, but which hold a secondary rank, as respects the importance of a knowledge of them to the physician. I. H.

ACCIDENT. *Accidens*, Lat. (From *accidere*, to happen.) In its most extensive signification means every fortuitous and unforeseen occurrence. In *pathology* it is employed by the French, as synonymous with *epiphenomena* (q. v.); that is, to designate those symptoms which supervene during a disease, but which are not necessarily connected with it. I. H.

ACCIDENTAL. (Path.) That which happens unexpectedly. *Accidental symptom*, an epiphenomenon, (*q. v.*) *Accidental tissue*, a structure developed by a morbid action. I. H.

ACCLIMATED. (Hyg.) *Climati assuetus;* accustomed to a climate. I. H.

ACCLIMATEMENT, or *seasoning*, is the result of the changes which take place in the animal system, from a prolonged residence in a climate different from that to which it had previously been accustomed, and which changes assimilate it, in a greater or less degree, to that of the natives of the country.

In giving this definition of acclimatement, it should be borne in mind, that climate, in a medical point of view, has a more extended signification than is given to it in common parlance; in fact, the climate of any particular locality, when considered with reference to its modifying influence on the human economy, is "the aggregate of the qualities of the atmosphere of that place, together with certain moral influences, which this aggregate controls and modifies." (CALDWELL.) Therefore, in examining the effects of a change of residence in producing a corresponding change in the vital functions, every thing connected with the new relations in which the individual is placed, should be allowed its due weight, as the mere thermometrical difference between situations, although undoubtedly of itself alone capable of producing marked effects, is by no means sufficient to explain all the changes which the system undergoes.

Man is almost the only animal that can exist in the most opposite climates. Unlike the generality of other living beings, he is not the inhabitant of one region or zone only; on the contrary, he is, to a certain degree, migratory, and with proper precautions is capable of passing from the frozen regions of the north to the burning plains of the tropics, and his organization appears to be endowed with the faculty of at first, withstanding to a certain degree, the influence of atmospheric influences to which it had previously been unaccustomed, and finally, of undergoing such a modification as to enable it to sustain the constant action of those influences with comparative impunity.

But this transition from one climate to another, cannot be suddenly effected without risk. Every check to the habitual play of the animal functions is attended with more or less danger; hence, when inhabitants of one part of the globe emigrate to another, of different temperature, &c., they become subject to a new series of impressions, and of necessity a new series of effects dependent on these impressions, must be the result; and the struggle, as it were, between the long established and habitual actions of the economy, and those which are induced by the unaccustomed stimuli to which the systems of these individuals are now exposed, must be productive of disease; in time, however, the new series of actions gain the complete ascend-

ancy, and such a modification of the functions is effected as to render the very impressions which were at first deleterious, necessary to a proper performance of the vital actions.

An elucidation of the precise change that takes place during the process of acclimatement, and the manner in which a difference of temperature acts on the human system so as to produce the final and well marked phenomena that attend its completion, is by no means an easy task; stimuli affect individuals in so diversified and oftentimes opposite a manner, that no general rule of action can be laid down. The following facts, however, appear to be sustained by all the evidence that can be gathered. When an individual is suddenly exposed to a temperature wholly dissimilar to that to which he had been long accustomed, two of his most important vital functions undergo a marked modification, viz.—respiration and calorification. From the experiments of Edwards, it appears that when animals are subjected to the influence of cold, they consume a greater proportion of air, and consequently develop more heat than when they respire a more temperate atmosphere. Hence it results, that when an inhabitant of a southern climate is suddenly exposed to the rigor of a northern winter, his power of creating animal heat being proportioned to the temperature in which he had lived, is insufficient to protect him in the new relations in which he is placed; a change is therefore required in this function, to enable him to withstand the influence of the cold on his system; and as this power is in exact relation to the quantity of air consumed in respiration, it follows as a necessary consequence, that his lungs must act with an energy to which they had hitherto been unaccustomed. This increase of activity, however, can seldom be effected without in the first instance inducing an irritation or even inflammation of these delicate organs.

On the contrary, when a native of a northern climate visits a tropical region, an opposite series of phenomena is induced. The faculty of producing a quantum of heat sufficient to preserve the integrity of his organization against the influence of the low temperature of his native country, still continues unimpaired for a certain period after his arrival in a warmer atmosphere, causing the abundant flow of perspiration so much complained of by strangers in a hot climate. This activity of the respiratory organs, however, gradually diminishes; but at the expense of some other apparatus, and most generally of the circulatory. The circulation becomes accelerated, hemorrhages often occur, and congestions take place in various parts of the system, but especially in the brain and digestive organs, producing dysenteries, fevers, &c. The effects of these two influences are strikingly manifested in the island of Ceylon, the centre of which is inhabited by both Europeans and negroes; and as the temperature is much warmer than that to which the former were accustomed, they are affected with the diseases of hot climates, whilst the latter, on the contrary, being subjected to a degree of cold far below that of their native country, fall victims to diseases of the pulmonary organs. (Andral, *Dict. de Méd. Prat.*)

Northern acclimatement. It is an exceedingly common error, that a change from a warm to a cold climate is attended with benefit rather than danger; nothing, however, is more indisputably false. Natives of a southern climate, emigrating to the north, are as liable to fall victims to diseases produced by change of residence, as are the inhabitants of the north on visiting a southern latitude; for though the maladies of the south are most violent and sudden, those of the north are by far the most numerous. There is even one circumstance which inclines the balance in favour of the change from north to south, namely, that when strangers have once passed through the process of acclimatement in a warm latitude, they are, comparatively speaking, as safe as natives of the country, whereas the southern emigrant to the north is never protected against the effects of a low temperature. If his pulmonary system becomes affected, no length of residence will so modify his respiratory organs, as to render them capable of bearing with impunity the increased action, to which, as before stated, they are necessarily subjected. Thus, the young negroes sent to England by the Sierra Leone company, for their education, bore the first winter tolerably well, but suffered considerably during the second, and usually fell victims during the third to some pulmonary disease. (Pearson.) The same train of circumstances occurred with the Maroons transported from Jamaica to Nova Scotia, except that the first winter was unusually fatal to them. (*Edin. Rev.*)

There is one fact connected with this part of the subject, that at the first glance would appear to contradict what has been said with respect to the functional changes that occur in natives of warm countries on

their visiting the higher latitudes, namely, that during the first, and sometimes even the second winter of their exposure to the impression of cold, they do not suffer from it to that degree that might have been expected. Thus, LARREY states that during the retreat of the French from Moscow, that individuals of a dark complexion and of a bilio-sanguine temperament, almost all natives of the south of Europe, resisted the severe cold better than those of a fair complexion, who were with few exceptions inhabitants of northern situations. The cause of this apparent exemption may be explained on the same principles by which the sensation of warmth on the surface, after coming out of a cold bath, is accounted for; that the impression of the cold induces a sufficient degree of reaction in the system to keep the skin at an agreeable temperature. This phenomenon, however, does not occur with all individuals emigrating to cold climates: on some, the unaccustomed decrease of heat induces a lethargic state, which in many respects is not dissimilar to that of hibernating animals at the approach of winter.

The great object of southern visitors to northern climates, should be to guard against the impression of cold on their respiratory organs, and not to allow the increased energy which is attained by their digestive apparatus, to lead them into excesses in food. Every symptom of pulmonary irritation, however trivial it may appear, should be promptly combated, and the strictest attention paid to keeping the surface warm, until the relaxed condition of the cutaneous exhalants so common in the natives of warm climates, has disappeared. The susceptibility of this class of individuals to diseases of the respiratory organs, is strikingly exemplified if they should unfortunately be attacked soon after their arrival, by either measles or small-pox, in which case, it requires the utmost care and attention to prevent their falling victims to the laryngeal and bronchial affections attendant on these diseases.

Southern acclimatement. The effects of warm climates on northern constitutions is, however, much more interesting in many points of view. The change in the organic functions is more prompt and complete, and the opportunities of observing it are much more numerous, as the tide of emigration from the earliest ages has constantly pursued a southerly course; a few individuals, it is true, occasionally advance in an opposite direction, but their numbers are too insignificant to attract notice, whereas the stream that is perpetually flowing from north to south is too important to escape observation.

It must be premised, before entering on this subject in detail, that the climate of countries situated in the same latitude differs exceedingly in its influence on strangers. Thus, of the same number of Europeans embarking for the unhealthy parts of India and South America, a greater proportion of the latter would perish during the first year after their arrival, but the acclimatement of the remainder being more complete, a far greater number would probably be alive at the end of ten years, than of those who established themselves in the eastern hemisphere. This fact has been fully proved in English regiments sent to the East and West Indies. Of a thousand British troops arriving in Jamaica, it has been calculated that between a third and a half perish during the first year after their disembarkation, whilst of a similar number sent to India, not more than a fourteenth will fall victims to the climate during an equal space of time. But, as has been before observed, this disproportion of mortality diminishes every succeeding year, till finally, in about five or six years, the loss of both parties will have been about the same.

On first landing in a tropical climate, the standard heat of the body of a stranger from the north is raised several degrees, for the temperature of the atmosphere, even in the shade, approaching closely to that of the blood, and in the sun even exceeding it, the animal heat generated by the process of respiration, cannot be abstracted by the surrounding medium; the consequence would be a destruction of the vital functions, in a very short space of time, if nature had not provided a mode of relief, in a copious flow of perspiration, which tends to restore the temperature of the body to a healthy equilibrium. This perspiration, when excessive and long continued, is soon followed, from the intimate connexion between the surface and the mucous membrane of the alimentary canal, by a loss, or rather diminution, of the digestive powers. This over-action of the cutaneous vessels also induces another complaint, common to almost every stranger on first landing: this is the prickly heat, which, though a source of great irritation, is attended with no danger, and is only to be obviated, until the system becomes acclimated, by quiet, light clothing, &c. At one time it was considered extremely dangerous to repel this eruption by cold bathing, or even washing the body with cool water; experience, however, has amply

demonstrated that no ill consequences arise from the freest use of baths, as regards their repelling effects.

After a northern visitor has been a certain time in a warm climate, and generally during the first summer, he is attacked with a fever which is dangerous in proportion to his neglect of precautionary measures. These should be commenced even before his arrival; for it has been remarked that emigrants to a tropical climate suffer in proportion to the excesses they may have committed during the voyage.

It is too common an idea that the increased temperature of tropical regions causes a disposition to debility in those unaccustomed to its influence, and that this disposition must be overcome by the use of stimulants; experience has, however, most incontestably shown, that a stranger in a warm climate has little to dread from debility or its consequences, whilst he has everything to fear from irritation and inflammation of his most important vital organs. He should therefore restrict himself both in the quantity and quality of his food, and cautiously avoid every excess, especially in fruits, as the immoderate use of them, so common to new-comers, is very apt to augment the already excited condition of the alimentary canal. The use of spices and other condiments so freely indulged in by the native, is eminently injurious to the unacclimated stranger, from their exciting the stomach to greater efforts than are compatible with a due performance of its functions.

As regards drink, much difference of opinion has existed among writers conversant with diseases of warm climates. Thus, Currie and Curtis recommend the use of gently stimulating liquids, stopping short of intoxication, as proper to give tone to the stomach and to prevent a check to the perspiration. This pernicious doctrine, however, has met with a most triumphant refutation, of late years; and it has been incontestably proved that the nearer a stranger approaches to a perfectly aqueous regimen in drink, more especially during the first year of his residence in a tropical region, the greater is his chance of passing through the process of acclimatement with safety. If, in northern climates, the free use of spiritous liquors occasions diseases of the stomach and liver, how much greater an influence they must exercise over these organs when they are predisposed to irritation by the effect of atmospheric temperature! There is one circumstance, says Johnson, that should always be borne in mind, that when a course of temperance is fully entered upon, no consideration should induce an occasional indulgence in spiritous drink, especially during the first year, as there is more danger from such a course, than even from an habitual use of these stimulants. These observations are fully confirmed by the success which has attended the relinquishment by the seamen in United States' vessels of war, in warm latitudes, of their rations of spirits; instead of the sick bay being crowded with patients, the acclimatement of the crews was so gradual, and attended with so slight a disturbance of the system, that but few men at a time were ever unfit for duty. (*Hints for Naval Officers*, &c., by W. P. C. Barton.)

Broussais, however, recommends the use of aromatic waters, with the addition of a little spiritous liquor, and acidulated, by persons from northern latitudes, in hot climates, to repair the loss of fluids resulting from excessive perspiration. But he states, at the same time, that concentrated stimulants are always injurious, at least until these individuals had become acclimated.

An attention to dress is almost as necessary as that of moderation in diet. Thus, after entering the tropics, the use of linen is both uncomfortable and unsafe, and it should be replaced by cotton, which, from its slowness as a conductor of caloric, prevents those sudden checks to the perspiration, so dangerous in warm climates; for when the temperature suddenly alters, and sinks below that of the body, the cotton prevents that sudden impression of cold on the surface, that would take place if linen were worn. Johnson, in his tropical hygiene, also states, that a too frequent change of clothes, when impregnated with perspiration, is decidedly injurious, as inducing an increased action of the morbidly excited cutaneous vessels. The daily use of the cold bath is also eminently useful to new residents: it tends to moderate the abundant perspiration: it should, however, be used in moderation, and never immediately after a meal, or where any visceral derangement exists. Broussais, in his admirable propositions, thus sums up the course of conduct to be pursued: "Acclimatement to a hot climate is obtained by general bleeding, by a considerable diminution in the aliment, and by quietude; but excess in vegetable food and refrigerating drinks must be avoided, as producing indigestion, for this develops an irritation,

which becomes the germ of the dreaded gastro enteritis, or of a dangerous colitis. (Prop. 322.)

For further information on the hygienic measures to be pursued in warm climates, the works of JOHNSON and MOSELEY may be consulted with great advantage, more especially the former.

After an individual has passed a certain number of years exposed to the high temperature of the tropics, his return to a cold climate is attended with the same danger as if he were a native of the country he has left, and he must pass through the same process of acclimatement.

Hitherto we have only alluded to the effects of a change from north to south, and *vice versâ;* but emigrants are also subjected to a seasoning, in whatever direction they may move. Even a change of residence, especially in the decline of life, from the low and unhealthy coasts of our southern States, to a more elevated and salubrious district, has been shown to be attended with danger, and more particularly if there be any predisposition to diseases of the pulmonary organs. It is well known, that of the immense numbers of emigrants who yearly seek the fertile plains of the west, few escape without undergoing an attack of disease.

In whatever direction, therefore, the tide of emigration flows, the same general result is the consequence—such a change in the functions of the organs as will enable the system to bear with impunity the new impressions to which it is exposed.

All emigrants, therefore, who would escape disease, no matter to what point of the compass they have directed their steps, must pursue certain precautionary and hygienic measures. These may be stated in a few words. Temperance, a proper attention to clothing, an avoidance of unnecessary exposure and fatigue, and, after they have passed through their acclimatement, an adaptation, as far as possible, of their habits, to those of persons accustomed to the climate. It should also be borne in mind, that success in preventing or moderating the initiatory attack of disease, will depend, in a great measure, on the season of their arrival. Thus, emigrants from north to south should never arrive during the spring or summer months; whereas, strangers from the south should beware of subjecting themselves at once to the rigour of a northern winter.

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ACEPHALOBRACHUS. (From a priv. κεφαλη, head, and Βραχιων, arm.) A fœtus without head or arm. See *Acephalous.* I. H.

ACEPHALOCHEIRUS. (From a priv. κεφαλη, head, and χειρ, hand.) A monster without head or hands. See *Acephalous.* I. H.

ACEPHALOCYST. (From a priv. κεφαλη, head, and κυστις, bladder.) This name has been given by Laënnec to a genus of hydatids, characterized by consisting of a vesicle without head or any appendix. See *Hydatids.* I. H.

ACEPHALOGASTER. (From a priv. κεφαλη, head, and γαστηρ, stomach.) It has been proposed to give this name to monsters devoid of head, chest, and abdomen; or to those having an abdomen without head or chest. I. H.

ACEPHALOSTOMA. (From a priv. κεφαλη, head, and στόμα, mouth.) An acephalous fœtus, having at its upper part an opening resembling a mouth. I. H.

ACEPHALOTHORUS. (From a priv. κεφαλη, head, and θωραξ, chest.) This epithet has been proposed for monsters devoid of head and chest; or for those which possess a chest and abdomen, but are devoid of a head. See *Acephalous.* I. H.

ACEPHALOUS, or *Acephalus.* (From α priv., and κεφαλη, head.) This term, which literally means a being without head, has been variously employed by writers, some of them not only applying it to those fœtuses in which all vestiges of a head are absent, but also to those cases in which the head is imperfectly developed. We shall employ it in the restricted sense in which it was used by CHAUSSIER and BECLARD, confining its application to such monstrous fœtuses as come into the world entirely destitute of a head, and including

those cases in which that portion of the body is partially developed under the terms *Anencephalus*, *Hemicephalus*, &c. It should be stated, however, that such monstrosities frequently present, at the same time, a defect of some other portion of the body; as, for example, the neck, the thorax, a part of the abdomen, and a part or the whole of the extremities—a deficiency which may be very well included under the head of *Acephalus*, inasmuch as, when it exists simultaneously with that condition, it is a result of the same interruption or perversion of the acts of the formative powers as those which give rise to the absence of the head. This coincidence between the absence of the head and the simultaneous deficiency of other portions of the trunk of the body, is illustrated by a great number of cases furnished by the records of the science, and has been especially considered by Sandifort, Chaussier, Meckel, Beclard, Tiedemann, Breschet, and others. Sandifort, Beclard, and Breschet, have made it the basis of a classification of these monstrous productions, which they have subdivided into varieties, according to the parts that are absent.

According to the classification of Sandifort, monsters are divided into the three following varieties: 1. Monsters destitute of a head; 2. Monsters with an absence of the head and some other organs; and 3. Those in which the object is amorphous, or entirely destitute of any definite form. This arrangement is too defective to be of any utility, and is very inferior to that proposed by Beclard. He makes five varieties, founded upon the parts that are deficient. The first he denominates *Acephalus simplex*, including those cases in which the *head* alone is absent; the second, *Atrachelo-cephalus*, in which a part or the whole of the *neck* is also absent; the third, *Abrachio-cephalus*, in which those parts, with the *arms*, are deficient; the fourth, *Apecto-cephalus*, in which the defect involves the *upper* part of the *thorax*; and the fifth, *Athoraco-cephalus*, in which the whole of the *thorax* and a *part* of the *abdomen* are deficient. The classification of Breschet is founded upon the same principles, and differs but slightly in its details. He makes only four subdivisions, which he denominates *Acephalus simplex*, *Acephalo-stomia*, *Acephalo-thorous*, and *Acephalo-gaster*, according to the parts that are absent.

In the observations which we propose to make relative to Acephalous monsters, we shall consider, first, those in which the head alone is deficient; second, those in which the deficiency involves the upper and lower extremities; third, those in which the upper portion of the vertebral column is absent; fourth, those in which the inferior portion of the spine is deficient; fifth, those which consist in a defect of a part or the whole of the thorax; sixth, those in which a part of the abdomen is deficient; and seventh, those which are accompanied with an absence of one or more of the organs. The consideration of the subject in this order will lead, in regular succession, to an examination of all the topics of importance connected with the configuration and structure of these organic deviations, and will enable us to appreciate the reciprocal influence of the different organs, to determine their relations, and to ascertain, with more accuracy, the probable modifications of the laws of the living organism which are instrumental in inducing such a singular departure from the normal type of the individual.

One fact of considerable importance, connected with the form of monstrosity under consideration, is, that a large proportion of the cases of acephalous fœtuses which have been reported, have been the product of twin conceptions: some of them, indeed, have been instances of three or four children delivered at a single birth, all the others being well formed, and one only exhibiting indications of an arrest of development. It has been stated by Meckel, Sir Everard Home, and others, that this is a common occurrence in monstrosities of defect, most of them being examples of twin-births, one child only having attained its full development.

Thus, in the cases reported by Mery, Henkel, Clarke, Cooper, Monro, Lamure, Mauriceau, Odhelius, Mappus, Gilibert, Gourraigne, Winslow, Isenflamm, Lecat, Lankisch, Poujol, Vogli, Katzky, Kundmann, Antoine, Buttner, Busch, Everhard, Schellhammer, Aldrovande, Klein, Giel, Treviranus, Atkinson, and in two of those published by Tiedemann, the mother was at the same time delivered of a second child, which was well formed. Meckel. (*Handbuch der Pathologischen Anatomie*, Band I. p. 56. Leipzig, 1812.) Breschet. (*Dictionnaire de Méd.* Art. *Acephalie.* Tom. I. Paris, 1821.)

In the examples reported by Seeliger, Supperville, Kalck, (*Monstri Acephali expositio Anatomica*, Berlin, 1825,) Kundmann, (Breschet, *loc. cit.*) and in one published in the *Ephemerides de nat. curios.*,

there were two perfectly formed fœtuses born at the same birth; and in one of Tiedemann's cases, there were four fœtuses.

According to the observations of Breschet, the instances reported by Sulsmann, Doneaud, and Vallisnieri, furnish the only well-authenticated examples of this species of monstrosity, in which the conception was single, and even in these cases it is said that a large number of hydatids were discharged at the period of delivery.

The disposition of the membranes is not always the same. Sometimes each fœtus has a distinct placenta, and a membranous envelope proper to itself. Occasionally the monstrous fœtus is included in a separate membrane from that which envelopes the other, but is attached to the same placenta. This was the arrangement in a case reported by Henkel. The umbilical chord of the Acephalous fœtus was, however, only about three inches in length. More frequently both, or all three, are contained in the same set of membranes, and are attached to the same placenta. Tiedemann reports a case in which the placenta to which the monstrous fœtus was attached, served, at the same time, for three other well-formed fœtuses. Generally each child has a distinct umbilical chord, but occasionally a single chord comes off from the placenta, and divides to send a branch to each. In Mery's case, it bifurcated shortly after leaving the placenta, one division going to the perfectly formed fœtus, the other to the monster.

§ 1. *Head alone deficient.* (*Acephalus simplex.* Beclard, Breschet.) In a number of cases of the simplest forms of Acephali, it is difficult to decide whether the head is entirely absent, or whether some of its parts exist in a rudimentary condition. This is especially the case when all the vertebræ are formed; for, under such circumstances, the superior extremity of the trunk of the body usually terminates in a small rounded prominence, covered by the skin, and sometimes by a small quantity of hair, in which, on examination, small particles of bone and other structures may be observed, which probably constitute the germs of a part of the cranial bones. This mass, moreover, generally contains in its centre the superior termination of the spinal marrow, from which, in some cases, the origin of the nerves may be distinctly traced. In many cases, indeed, in which a considerable portion of the vertebral column is absent, its upper extremity is terminated by a small rounded prominence of this kind, covered with skin and hair, similar to that which occupies the head of a well-formed fœtus; the mass itself being either solid, and composed of fragments of bone connected by loose cellular tissue, or occupied by one or more small cysts, filled with a serous fluid. But of the difference of aspect and structure of this superior terminal portion of acephalous monsters, we shall have occasion to speak more particularly in the course of our observations.

It should be stated, that although it is only intended to include under the first division of the subject, (*Acephalus simplex,*) those cases in which the head alone is deficient, there are but few cases which, strictly speaking, present this character, inasmuch as the same interruption or arrest of development that gives rise to an absence of that part, generally influences, at the same time, the superior portion of the cervical vertebra, so that although they may exist in a rudimentary condition, they are never perfectly formed when the head is absent. Frequently, they merely consist of small nuclei of bone, and sometimes only exhibit a number of small irregular masses of a cartilaginous structure.

The case which presents the most perfect development of these parts, and the nearest approximation to the formation of a cranium, is one described by Curtius. (*De monstro humano.* 1762. Meckel.) In the place of the head, there was a small half-globular tumour covered by the skin. Upon the front of this prominence, there were three openings, which all communicated with each other; and on the right side, a small blind appendage. The ears and nose were absent, but the situation of the latter was occupied by two small excrescences, beneath which was a third, which was probably the rudiment of the tongue. These prominences were not separated from the body by any distinct furrow or depression; there were, nevertheless, seven cervical vertebræ, and a piece which resembled the base of one of the cranial bones. The rudiments of eyes were perceptible on each side of the situation of the nose. The rudiment of the cranial bone was round, and nearly all the bones of the face were absent. There were, nevertheless, two bones, which were probably the rudiments of the upper jaw; a temporal, an occipital, and two frontal bones. The cavity formed by these structures, when compared to the size of the bones, did not present more than half its proper capacity, and was lined throughout with the dura mater. The internal surface did not exhibit its natural conformation, but presented several small eleva-

tions and depressions, similar to those occasioned by the convolutions of the brain.

In a case observed by BUTTNER, (*Anat. Wahrnemungen*, p. 190. MECKEL.) in which the head and arms were absent, the place of the former was occupied by a spongy, rounded mass, covered by skin and fine hair, which was separated from the trunk by a kind of intersection. This mass contained the rudiment of the occipital bone, with a small portion of the dura mater, but no vestiges of the substance of the brain.

In ZAGORSKY's case, (*Acad. Petrop.* Tom. XV. 1806. MECKEL.) the spine, which was terminated above by the atlas, was surmounted by a small hook-like process, which was flexed forwards upon the breast. This projection was invested with skin and a small quantity of hair, but contained no rudiments of a bony structure. It was occupied by a gelatinous substance, and was not separated from the trunk by any distinct line of demarkation. In the case reported by COOPER, (*Phil. Transactions*, Vol. LXV.) however, there was a very small, imperfect, rudiment, or excrescence, occupying the centre of the tumour.

In a case observed by MECKEL, (*Abhandlungen für mensch. und vergleich. Anat.* p. 173.) there was situated above the dorsal vertebra, an elongated pointed projection, composed of several irregular masses of bone, which were probably the rudiments of the cervical vertebra, and a part of the cranial bones.

In all these cases, notwithstanding the bones of the head were partially or entirely absent, the cervical vertebræ were either perfectly formed, or existed in a rudimentary state. There seems, moreover, to have been, even in those which were most imperfect, an abortive attempt to form the cranium, which was probably thwarted by the process of development having been arrested at a very early period, while the parts were yet in a rudimentary condition. It should be stated, however, that in many cases in which the cervical, and even a considerable portion of dorsal vertebræ are absent, the evidences of the rudiments of the cranial bones, or of a tendency to the formation of the head, may be observed; the superior portion of the trunk frequently presenting, under these circumstances, a small prominence of variable size and configuration, generally covered by skin, sometimes clothed with fine hair similar to that of a well-formed fœtus, and sometimes exhibiting traces of a mouth, nose, eyes, or some other part of the face.

In one instance observed by SUPERVILLE, the upper extremity of the trunk terminated by a small fleshy vesicle, which contained a watery fluid. In LECAT's case, (*Phil. Trans.* Vol. LVII.) the upper part of the extremity of the trunk, which terminated in a small projecting mass of cartilaginous nuclei, was covered on the left side with skin and hair similar to that of a new-born fœtus. It was also surmounted by a nipple-like mass, which was covered by a fleshy structure, having the appearance of an imperfectly formed muscle. The cartilaginous prolongation was hollow, and contained the rudiment of a brain of a cubic inch in magnitude. There was, towards the lower part of this figment of a cranium, a small opening which conducted to a kind of blind oral cavity. There were also some traces of the right side of the lower jaw; and towards the upper portion of the prominence, some evidences of the rudiments of an eye. ODHELIUS (*Neue Swedesche Abhand.* 1785. MECKEL.) also reports an instance in which, in the situation of the mouth, there was a small fold of the skin, which, when examined with a probe, conducted the instrument deep into a mass of cellular tissue. In the situation of the left eye, there was a similar excavation. When the parts were laid open, a thick strong membrane was exposed, which was probably a portion of the dura mater. This being punctured, about a quart of a clear limpid fluid escaped. The opening of the dura mater exposed four pieces of bone, which seemed to be the rudiments of the two parietal, and two portions of the occipital bones. There were also some serous vessels contained within the cavity, but no evidences of any portion of brain. WINSLOW (*Mém. de l'Acad. des Sciences.* 1740.) observed a small mulberry-like excrescence situated between the shoulders, and upon the thorax, which was covered by the skin, and presented a small transverse fold similar to the mouth, and likewise some appearances of the rudiments of the right eye. GOURRAIGNE (Ibid. 1741.) also observed a small fleshy excrescence between the umbilicus and the upper part of the body, which was covered with skin and hair. ISENFLAMM (*Beitrage zur Zergleiderungskunst.* Bd. II. p. 281.) reports a case in which the spine terminated in an elongated beak, containing several small pieces of cartilage, which he considered might be nuclei of the cranial

bones. In two of the cases described by TIEDEMANN, (*Ueber den Kopflossen missgeburten,*) the spine terminated in a small pointed projection, covered with skin and a small quantity of hair, beneath which there was a small mass of cellular tissue; and in that observed by TREVIRANUS, there was a small tumour presenting the same appearance. BUSCH, HEURMANN, and PROCHASKA, report similar cases; and in one example observed by POUJOL, nearly the same circumstances were observed as in the case described by GOURRAIGNE. In KUNDMAN'S, and DONEAUS' cases, there was a simple rounded excrescence, situated, in the one, above the umbilicus, and in the other, between the shoulders. (BRESCHET. *Loc. Cit.*, p. 258.) This was also the character of one of the cases reported by BECLARD: there was merely a small fleshy tubercle upon the anterior part of the thorax, which was covered by the skin.

A patient analysis of these cases will furnish some important illustrations of the manner in which the defect of the head and other parts which are concerned is induced. We find in them a gradual transition from that degree of imperfect development, in which the brain and the bones of the head furnish manifestations of a tendency to assume their natural form, to those in which they, with even the cervical and a portion of the dorsal vertebra, are absent, and which exhibit no evidences of the rudiments of the head and neck but a small fleshy or vesicular excrescence ingrafted upon some portion of the trunk of the body. Under all the circumstances which have been detailed, nature seems to have made an effort to accomplish her purpose. Her plans were properly arranged; the rudiments of the different parts were properly disposed; the formative powers had even commenced to mould them into their appropriate configuration, and to place them in their proper relations; but their energies being too feeble to accomplish the task imposed upon them, or their operations being arrested, while the other organs, uninfluenced by these causes, continued to be regularly evolved,—an arrest of development occurred in the parts which were found defective; their growth was interrupted, and they consequently remained in the condition which they presented during the first months of the fœtal existence, whilst the other parts attained their perfect development.

A reference, however, to the condition of the *ovum*, during the first three or four weeks of its development, will be necessary to furnish a satisfactory explanation of the manner in which these changes are induced. It has been ascertained that, about the expiration of this period, the rudiment of the human fœtus presents itself in form of an elongated mass, of a gelatinous consistence, slightly flexed upon itself. It is transparent, and of a delicate structure, and is merely suspended by the slender umbilical vessels. Both extremities of this body present a small transparent rounded prominence, the one corresponding to the head, and the other to the breast. The central portion also exhibits a circular zone, or elevation, at the point at which the fœtus is united with the umbilical vessels. (TIEDEMANN. *Anatomie de Cerveau.* p. 11–12. Paris, 1823.) There is as yet no evidence of the development of any of the organs; no traces of them can be perceived; the two rounded transparent extremities are filled with a pellucid fluid, and are of a vesicular character, while all the other portions are, for the most part, gelatinous, and of a homogeneous structure. No appearances of the cerebral or nervous structure are perceptible at this period, and consequently the rudiments of the bones of the spine and cranium are not yet obvious. This vesicular character of the parts which constitute the head is common to the primitive condition of the embryo of both the mammalia and birds, and has been particularly noticed by HARVEY, DE GRAAF, HALLER, MALPIGHI, WOLFF, SŒMMERING, MECKEL, BOJANUS, DÖLLINGER, PANDER, OKEN, TIEDEMANN, BAER, and BRESCHET. It has been ascertained, moreover, by MECKEL, that at first the whole length of the body presents the same dimensions; that it is then divided into two portions, one of which corresponds to the head, and the other to the tail, and that of these two divisions, the latter soon obtains a preponderance of development. The same relationship is, however, not always observed. In an embryo of two lines in length, which was examined by the author just quoted, the body was divided by two superficial intersections into three segments, of which the upper and lower presented nearly the same volume; or, at least, there was but a very slight preponderance of size in the upper. In an embryo of three lines in length, the dimensions of the body were the same throughout, and the two extremities were considerably separated from each other by the intermediate segment. (MECKEL. *Beitrage zur Vergleichend. Anat.* Bd. I. No. V.) At a later period than this, (about the expiration of the eighth week, according to WRISBERG,

Sœmmering, and others,) the line of demarkation between the head and trunk becomes distinct, and in proportion as this takes place, the several segments of the body gradually assume, by a more perfect evolution of their parts, more of those characters which eventually serve to distinguish them. It has been observed by Tiedemann, that about the sixth week after conception, the length of the whole body of the embryo is about four or five lines. The head is large, and inclined forward; there is frequently a small fissure corresponding to the mouth, and two small eyes which are destitute of palpebræ. (*Loc. Cit.* p. 13.)

It will be seen, therefore, if the several grades of monstrosity which have been detailed above be referred to an arrest of development, that the suspension must have taken place in most of them previous to the expiration of the sixth week after conception, or during that period at which the head is not fairly separated from the trunk by any distinct line of demarkation, and, consequently, before any rudiments of the brain, cranium, mouth, or eyes, had become manifest. The cephalic extremity of the body, as has been already stated, merely consists of a rounded prominence of a transparent character, filled with a limpid fluid, and it has been seen that in a considerable proportion of the cases which have been observed by writers, the small excrescence, which occupied the place of the head, presented an arrangement of this character.

In some instances, however, the arrest of development only takes place at a later period. In some of the cases which have been cited, the cephalic excrescence did not present the simple character just alluded to, but exhibited traces of mouth, eyes, nose, and even the nuclei of the vertebral and cranial bones. It is possible, however, even under these circumstances, for the disturbance to have taken place during the first weeks; for on the supposition of a mere enfeebling of the energies of the formative powers of the parts concerned, without a complete suspension or arrest of their acts, it can readily be conceived how the other portions of the body, which have experienced no interruption or disturbance in their progressive evolution, might be perfectly formed at the period of delivery, while those in which the formative or plastic powers of the system were enfeebled, would still remain as it were in a rudimentary condition.

§ 2. *Neck partially or entirely deficient.* (*Atrachelo-cephalus.* Beclard.) The second degree of Acephalous monstrosity is that in which the cervical vertebræ are either imperfectly formed, or entirely absent. But here, as in the preceding variety, the defect frequently extends to other parts, so that there is not only an imperfect development of the neck, but sometimes of the superior extremities, and various other regions of the body. There are, indeed, but few cases in which an arrest of development in the neck does not involve a corresponding defect of some part of the thorax and abdomen, and especially of some of the organs contained within their cavities. This, however, will be more fully illustrated by the observations which we shall have occasion to detail.

In consulting the recorded examples of Acephalous monsters, we generally find that but little attention has been paid to the condition of the cervical vertebræ; so that we shall be obliged to confine our citations to the few cases in which the reporters have attended to that circumstance, omitting, at the same time, many others, in which some of the cervical vertebræ doubtless existed in a rudimentary condition.

In one of the cases already quoted from Meckel, the upper part of the dorsal vertebra was surmounted by a kind of beak, containing a number of small irregular masses of cartilage, some of which were probably the rudiments of the cervical vertebra. (*Abhandlungen fur mensch, und vergleich. Anat.* p. 173.) In another instance, reported by the same individual, the dorsal vertebræ were so confounded with each other that only nine or ten could be determined with accuracy; and above them, the cervical vertebræ, which were open behind, were also united with each other, and were inclined towards the right side. Along the left border of the mass formed by the union of these bones, there were seven small apertures for the transmission of the cervical nerves. (*Beitrage, zur mensch, und Verg. Anat.* p. 143.) Clarke and Henkel saw the spine terminating abruptly on a level with the first cervical vertebra; and Isenflamm, in the case already quoted, found only eighteen vertebræ; and above them, an assemblage of small particles of cartilage and bone, which he considered as the rudiments of the bones of the head, but which, as has been suggested by Meckel, may have belonged rather to the vertebra of the neck. In a case observed by Klein, there were nineteen vertebræ, but no indications of the development of the head; and in the case reported by Mery, the

spine terminated at the first dorsal vertebra. GILIBERT also witnessed a case in which the spine was composed of only seventeen articulations. The upper one was filled up by compact cellular tissue; and above its left transverse process, there was a collection of small bones of the size of a common nut.

These cases, taken in conjunction with some of those which have been already referred to under the first division of our subject, indicate all the intermediate degrees of deficient development between those cases in which all the cervical vertebræ were fully formed, as in the examples reported by SUPERVILLE and LECAT, and those in which all these bones are absent, as in the instance observed by MERY. In the transition from the one of these extremes to the other, the bones manifest different degrees of development, one or more of the cervical vertebræ being in some cases properly formed, while in others nothing more is manifest than a simple aggregate of small osseous or cartilaginous masses, as in the examples observed by GILIBERT, ISENFLAMM, and MECKEL.

The laws which control the development of these parts, furnish a very satisfactory explanation of these phenomena. The superior pieces of the spine being those which are last formed, whenever any thing occurs to disturb or suspend the acts of the formative powers of that region before the cervical vertebræ have assumed any definite form, or while they still retain the character of simple amorphous *nuclei* or rudiments, the portions thus affected will retain the characters which they possessed at the time the interruption occurred; while the other portions of the spine will pass successively through their several transitions, and will be perfectly evolved.

§ 3. *Acephalous Monsters with defective development, or entire absence of the Thorax.* (*Apecto-cephalus.* BECLARD.—*Acephalo-thorous.* BRESCHET.)

An examination of the different degrees of defect which are exhibited by Acephalous monsters, in the several parts of which the thorax is composed, will demonstrate, that the order in which they occur is precisely in a ratio with the order of their development; those which are last formed being more frequently involved than those which are earlier in attaining their appropriate forms. Thus, the two lateral portions of the vertebra are the first to make their appearance: to these succeed the spinal extremity of the ribs: next, the full development of these bones; and last of all, the sternum. The latter bone is, therefore, the most liable to an arrest or interruption of its development: the next in liability are the ribs; after which, the vertebræ themselves may be implicated, either as regards their posterior portion, which is the last formed, or a part or the whole of one or more of their bodies. These defects are, moreover, generally accompanied with a corresponding anormal condition of some of the thoracic organs, as, for example, *ectopia* of the heart or lungs, an imperfect development of these organs, or their entire absence.

The first degree of the defective development of the thorax is manifested by an imperfect sternum, or an entire absence of that bone. Either of these conditions may exist alone, without a simultaneous deficiency of any other portion of the thorax; but in a large majority of cases, when the sternum has its development interrupted, there is an absence of a part of the ribs, or some modification of their attachment, and sometimes even a defect of some of the vertebræ. The sternum is always absent in such cases as are attended with a deficiency of all the ribs; and the organs of the thorax, if they exist, will, under such circumstances, be entirely exposed and unprotected.

In the case reported by GILIBERT, in which the spine terminated above with the first dorsal vertebra, the first rib on each side was wanting; and in KLEIN's case, there were only eleven ribs on the right side. In the fœtus examined by MERY, there were only nine ribs; in MONRO's case, all of them were absent except the six inferior; and in one published in the Memoirs of the Royal Society of Montpelier, the six lower ribs were wanting. MECKEL speaks of one case in which there were seven ribs on the right, and eight on the left side. Most of them were connected with each other; and all those on the right side, except the inferior, were composed of an anterior and a posterior portion. In two of the examples published by MALACARNE, the ribs merely existed in a rudimentary condition; and nearly the same thing was observed by SUPERVILLE and POUJOL. In the case described by the first, the only structures that corresponded to the ribs, were a few indistinct cartilaginous and osseous fragments. In POUJOL's case, however, there were five or six imperfect ribs engrafted upon the spine, of which number, two only were connected with a portion of the sternum.

In all these cases the sternum was either entirely absent or imperfectly developed. In those reported by SCHELHAMMER, SUPERVILLE, BUTTNER, one of those of MECKEL, two of PROCHASKA, and one by KATZKY, the sternum was entirely wanting. In the example reported by the last-named individual, a small aperture was observed situated between two small prominences upon the anterior part of the thorax, through which a transparent vesicle, filled with fluid, was protruded. In KLEIN's case, the cartilages of the ribs were inserted into an imperfect circular sternum; in that described by MOREAU, that bone only received the two first ribs; and in the instance reported by MAPPUS, the sternum was traversed by two small fissures. In the Acephalous fœtus observed by MERY, the whole of the sternum was absent, except the ensiform cartilage; in LAMURE's case, it was preternaturally small; in GILIBERT's, deformed; and in a case described by ISENFLAMM, the true ribs on each side were merely united by transverse bands.

It very frequently happens that while an arrest of development takes place in the sternum and ribs, the regular evolution of the dorsal vertebra is at the same time interrupted, this interruption either taking place in their posterior arches, and giving rise to a spina bifida, or implicating the bodies of the bones, and occasioning a total absence or imperfect development of one or more of them. In the cases already referred to, which have been published by MERY and GILIBERT, the spine terminated above at the first dorsal vertebra. MONRO, however, only observed sixteen vertebræ, of which five appertained to the loins, and eleven to the back. In one of MECKEL's cases, there were only eight dorsal vertebræ, with the ordinary number of those of the loins; and in another example observed by the same author, there were only two dorsal vertebræ, besides the five lumbar. Surmounting the summit of these bones, there were two small, irregular, solid bones, and opposite to them, two small, inconsiderable cartilaginous rudiments of the ribs. In SUE's and WINSLOW's cases, however, the spine was merely composed of the five lumbar vertebræ, all above that level being entirely absent.

In all these conditions, distinct indications are manifested of an arrest of development having taken place at some period during the evolution of the organs, the precise time at which such an interruption occurred being variable in different cases. In most instances, however, the state manifested by the malformed part at birth, furnishes a pretty accurate representation of their type at the period at which their evolution became arrested, the deficiency always being greater in proportion as such an accident occurs nearer to the period of conception. This is explained by a reference to the order in which the different parts are formed, and the manner in which one succeeds to another which is antecedent to it, and upon which it is dependent. Thus the vertebræ, being the part of the thorax in which the process of development first commences, and the ribs and sternum being entirely dependent upon them, whenever they are prevented from passing through their regular stadia of formation, or, in other words, are imperfectly evolved, neither the ribs or sternum will be developed, or will exhibit a defect corresponding to the imperfection of the vertebra.

The several pieces of which the spine is composed are first formed by three distinct nuclei, two of which correspond to the two lateral halves of the arch, while the third constitutes the rudiment of the body. The lateral nuclei are arranged in two series, which are at first separated from each other on the median line, and only become united in proportion as the development advances, and the parts approach the type which characterizes their perfect form. The lateral masses make their appearance about the third month, but the central portion is not visible until a later period, and a considerable time elapses before they all become consolidated. Should the development, therefore, be interrupted before these rudiments are formed, or after they have made their appearance, but before they have become united with each other, there will either be an entire absence of one or more of the vertebræ, or they will merely exist in form of irregular nuclei of a bony or cartilaginous character, which have no intimate connexion with each other.

The same observations will apply to the ribs. They make their appearance at a very early period on each side of the vertebral column, and by the end of the eleventh week, they are almost entirely ossified. But when any thing transpires to interrupt their regular development before they attain this condition, they will either be incompletely formed, will present themselves in form of small cartilaginous masses, or be partly or entirely absent. Under all these circumstances, the walls of the thorax will exhibit a deficiency corresponding to the extent of the imperfection or absence of the ribs.

The sternum is developed at a much

later period than the bones just mentioned. It is, at first, composed of two lateral half sternums perfectly distinct from each other, which are themselves, at the period of their first formation, constituted of several nuclei. In those which are situated above, the process of ossification goes on more rapidly than in those which are placed below. The two lateral portions, gradually expanding, meet each other upon the median line, and become consolidated, this union being always accomplished earlier in the upper than in the lower extremity of the bone. While the two lateral portions remain separate, there is an elongated perpendicular fissure occupying the central part of the anterior face of the thorax, in the course of which the corresponding portions of the heart and lungs are naked, or merely covered by their investing membranes. When, therefore, an interruption of development occurs before this opening becomes closed, the parts remain precisely in the situation in which they were when the acts of the formative powers became suspended, and the extent of the deficiency will be greater in proportion as the disturbance occurs nearer to the period at which the parts of the sternum become visible; or should the development be arrested at a still earlier period, the whole sternum will be absent, and the anterior portion of the thorax will exhibit an opening of considerable extent, corresponding to the magnitude of the deficiency. Thus, in tracing the characters of the Acephalo-thorax monsters, we observe a regular gradation from those cases in which the defect is inconsiderable, to the condition in which the entire thorax is absent. In the first place, the most simple degree consists in a defect of the sternum. To this succeeds the entire absence of that bone; and these deficiencies may either exist alone, or be accompanied with an imperfect development of one or more of the ribs. The next degree is the entire absence of those bones; then a defect of a part of the dorsal vertebra; and finally a total absence of all that portion of the spine, which, when it occurs, is accompanied with an entire deficiency of the whole thorax and its organs.

§ 4. *Acephalous Monsters, with an imperfect development, or total absence of the Abdomen.* (*Athoraco-cephalus.* Béclard. *Acephalo-gaster.* Breschet.) In many instances of the character just considered, the absence of a part, or the whole, of the thorax is accompanied with a similar defect of the abdomen. It is not our intention to include such cases under the head of Acephalo-gastrous monsters, but to restrict that term to those cases in which, while some part of the walls of the abdomen is imperfect, there is some defect of the lumbar vertebra, of the sacrum, coccyx, or innominata.

Cases of an entire deficiency of the abdomen are exceedingly rare; and it has even been questioned if such an accident could possibly occur, inasmuch as that region of the body always constitutes the point which is penetrated by the umbilical vessels; and it has been conceived that a fœtus could not be developed without the umbilical cord. There are, however, a few examples on record, which completely refute these arguments. Instances of partial defects of the abdomen in acephalous fœtuses are not unusual, such an accident constituting a very frequent concomitant of that form of monstrosity.

In some instances, the defect of the spine in acephalous fœtuses merely consists in the absence of one of the vertebræ. This was the case in an example observed by Gourraigne, in which the four inferior lumbar vertebræ only were perfectly formed; the first, which corresponded to the upper portion of the spine, merely consisting of an imperfect rudiment. In the cases reported by Everhard, Sue, and Busch, all the lumbar vertebræ were developed, but above them the whole trunk of the body was absent. In Mappus's fœtus, merely a small portion of the inferior part of the trunk was developed, consisting of an irregular mass, to which the short, deformed, inferior extremities were attached. The bones of the pelvis, which exhibited an anormal configuration, were as large as those of a well-formed child; but the muscles were imperfectly developed. This rude and formless monster was directly connected with the placenta, by means of a small prominence, which supplied the place of the umbilical cord. Hayn (*Monstri unicum pedem referentis Discriptio Anat. Berol.* 1824.) has given the history of an Acephalous fœtus which merely possessed the left lower extremity, without any of the viscera, an umbilicus, a small fragment of the pelvis, and one piece of the vertebra, which contained a small portion of nervous substance, from whence a single nerve passed off to be distributed to the extensor muscles of the thigh and the skin. Clarke has described a case in which the defect was still more considerable. There was a flattened oval mass, of about four inches long and three broad, to the central portion of which, an umbilical cord, of about an inch in length, was at-

tached. Connected with the upper end, there was the rudiment of one foot, which merely presented one large and two small toes; to the lower, a second foot, still more defective, but with the same number of toes. This rude mass also contained one innominata, besides the bones of one thigh and leg. HENKEL also observed an example of Acephalous monstrosity, in which the development was probably arrested at a very early period. The lower extremities existed in an imperfect state; but all the rest of the body seemed to be composed of a simple gelatinous substance, which was covered by the skin. RUYSCH (*Thesaurus. Anat.* IX. p. 17. Tab. 1.) also reports a case, in which, attached to the placenta of a well-formed fœtus, there was a lower extremity, composed of the thigh and a foot which had only three toes.

An examination of these examples of Acephalo-gastrous fœtuses, will demonstrate a regular gradation in the defect of the different parts of the abdomen. In all of them, the anterior walls of that cavity were absent; but in a part, the deficiency of the vertebral column was very inconsiderable. In the slightest degree, all the lumbar and sacral vertebræ were well formed; but from this point there was a gradual degradation, until the defect became so great as to amount to a complete absence of all the vertebræ, and even of the bones of the pelvis. This latter condition was only observed in the case reported by RUYSCH, which also furnishes the only example on record, of an entire defect of all the parts of the abdomen. In all the other instances, even in those communicated by CLARKE and HAYN, a small portion of the pelvis was observed; so that the abdomen may be said to have existed in a rudimentary condition, but was not perfectly formed; because the operations of the formative powers were arrested or interrupted, before the parts became properly evolved.

§ 5. *Acephalous Monsters, with an imperfect development, or entire absence of one or both arms.* (*Acephalo-brachia.* BRESCHET.) There are but few cases in which any considerable defect of development in any part of the trunk of the body, is not attended with a deficiency of some part of one or more of the extremities. In many instances, indeed, no traces of these members can be observed; but as the upper portion of the trunk of the body is much more liable to have its development arrested, than the lower, we much oftener meet with a defect or entire absence of the superior, than of the inferior extremities. In some instances, however, this absence is more apparent than real; there being, in many acephalous monsters, one or two small excrescences, or tubercles, upon some portion of the trunk, which represent the rudiments of the arms.

In the cases reported by RUYSCH, HAYN, CLARKE, MAPPUS, EVERHARD, and GOURRAIGNE, the upper extremities were entirely absent; and the same defect was observed in those of ZAGORSKY, SUPERVILLE, GILIBERT, MONRO, ODHELIUS, and MECKEL, notwithstanding all the dorsal, and, in some of the cases, a part of the cervical vertebræ, were perfectly formed. CURTIUS, SCHELHAMMER, HENKEL, BURTON, ISENFLAMM, WINSLOW, and MAPPUS, merely observed one or more teat-like excrescences occupying the situation of the arms. The same imperfect rudimentary arrangement of these members was noticed by COOPER, LECAT, MECKEL, and KLEIN. In the fifth case reported by TIEDEMANN, a similar excrescence constituted the only manifest indication of the existence of the right arm.

More frequently, some part of one or both arms, or some portion of the hands, are developed; but the acts of the formative powers being arrested, before their evolution is complete, they are imperfectly formed, and present an absence of some of their parts. In SCHELHAMMER'S case, the arms were inordinately short; the right hand had only two fingers, while, on the left side, the arm of which was somewhat longer, there were three. CURTIUS found the left arm longer than the right. The right hand was broad and flat, and the corresponding fingers were short and very thick. The left was divided, by a cleft, into two portions, each of which was surmounted by two fingers: the fifth finger was wanting. The left scapula was unusually small, and there was neither humerus nor radius in the arm, the ulna being the only bone interposed between the fingers and the shoulder. In LECAT'S case, the left side presented imperfect traces of the clavicle and scapula; and in that described by KLEIN, the right arm, which was flexed at the elbow, terminated in an obtuse point, which was surmounted by two small excrescences, similar in their appearance to fingers. SULZMANN observed that the arms, which were very short, terminated by a flattened extremity similar to the paws of a common mole; one surmounted by three, the other by four fingers. In ISENFLAMM'S case, the radius and ulna of the right arm were wanting; those of the left were curved. Each hand had

only four fingers, but the left only presented three metacarpal bones, two of them being united into one. HENKEL states that there was but one arm, which occupied the left side. The scapula was cartilaginous, and unconnected with the humerus. The fore-arm merely presented one small imperfect bone, and the only parts of the hand that existed were two fingers, which were united with each other. In the cases described by WINSLOW and BURTON, the arms were short, and in one individual, one hand presented three, the other four fingers; in the other, all the fingers were unusually small. BUETTNER merely found an imperfect scapula and clavicle on the right side, all the rest of the member being absent; and in one of the cases described by MECKEL, the left arm was well formed, but on the right side there was no clavicle, but merely a portion of the humerus, a radius and an ulna, and two metacarpal bones. In another case observed by the same individual, the place of the humerus and the radius and ulna was supplied by a long, flattened, irregular bone, which was terminated by two metacarpal bones and the same number of fingers. The whole of the left arm was absent, except the clavicle and scapula, which were destitute of articulating surfaces. In one of TIEDEMANN's cases, the right arm was absent; the left hand had only three fingers, although the arm was perfectly formed: and in one example reported by KATZKY, the members were destitute of bone, and were merely composed of muscles and tendons, covered by the common integuments.

Similar defects are sometimes observed in the inferior extremities, though, as has been already stated, they occur less frequently than in the arms. There are few cases of Acephalous monsters, however, in which there is not some defect of development of the lower members, either consisting in an absence of one or more toes, a deficiency of some part of the foot or leg, or a preternatural disposition of the parts which are formed. It has been remarked by MECKEL, that in all the examples of this species of monstrosity which he had examined, there was a defect of one toe, and the others were united with each other; and nearly all the cases which have been reported were characterized by a similar deficiency.

MAPPUS found the feet imperfectly developed; EVERHARD, the legs flexed inwards and crossing each other, and in both cases there was a defect of the toes. LECAT observed four toes on the left foot, which were united by a membrane; SCHELHAMMER and MERY, four toes on each foot; VOGLI, three; GOURRAIGNE, three on the right, while on the left the fourth and fifth were but partially separated from each other. In one of WINSLOW's cases, the thigh was curved inwards, and on the right foot there were only two, on the left, three toes. In another individual, he found on each foot three toes, and a mere rudiment of the fifth, which was composed of skin. BUETTNER's case was club-footed, and on the right side had only the great toe, on the left, that and the second toe. COOPER found all the toes united and deformed; SUPERVILLE, the right foot bent inwards; SANDIFORT, the lower extremities deformed; and ISENFLAMM, three toes on each foot. In the right foot, there were four metatarsal bones, in the left, five, the external of which were very small, and the third and fourth were united. In ZAGORSKY's and CLARKE's cases, there were three toes on one foot, and four on the other; while in that described by ODHELIUS, the foot was very short, and only had two toes. GILIBERT's case had three toes on one side, and two on the other; in LAMURE's, there were only two toes, and in MONRO's there was an absence of the patella and several bones of the feet and toes. In the monster examined by SUE, the left lower extremity was entirely wanting, and the right foot had only two toes. HAYN's case had merely the left lower extremity; and in one reported by RUYSCH, there was only the thigh attached to the placenta, which terminated in a foot with only three toes. The subject of TIEDEMANN's second case merely had two stumps terminating in a point, in which there was no distinct line of demarkation between the thigh and leg; and in the individual observed by VALLISNIERI, both lower extremities were entirely wanting.

All the different degrees of defect which have been detailed furnish an accurate representation of the type of the thoracic and abdominal members during the early periods of their development, and a satisfactory explanation of their occurrence can be readily found in an arrest or interruption of the operations of the formative powers, taking place before the different parts are properly evolved, thus leaving them in the imperfect state of formation which they present at the period at which the suspension of their development takes place.

During the first weeks after conception, the trunk of the fœtus is the only part that is perceptible. It is, however, partially divided, by a superficial transverse intersection, into two unequal portions, the

smaller of which subsequently becomes the head, while the other forms the trunk. No appearance of the thoracic or abdominal members can be perceived until about the end of the fifth week after conception, at which period they first become manifest, in form of small obtuse prominences. The superior, which are developed first, are situated immediately below the head; the inferior, which are formed a little later, occupy the anterior part of the caudal extremity of the trunk. According to Meckel, (*Manuel d'Anatomie*, III. 778,) these prominences are gradually elongated, and in the course of the sixth week, become divided into two segments, one peripheric, and the other central: these sections correspond to the hand and the forearm, and the foot and leg. Two weeks later, a third section makes its appearance in each member, which corresponds to the arm and thigh. These latter portions are, at first, much shorter than the other divisions of the extremities. Upon the extremity of the peripheric Segment, which is somewhat enlarged, there is generally developed, before this period, a small eminence, separated from the other portion of the member by a small constriction or furrow, which is gradually divided into several portions to form the fingers. These latter are, at first, short and thick, and continue, until about the third month, to be united by a kind of membrane, similar to the web which occupies the feet of certain birds, or the arrangement possessed by the cetaceæ. This connecting membrane first begins to disappear at the extremities of the fingers and toes, and finally admits of a separation of those members throughout their entire extent. The radial margin of the hand is formed rather earlier than the ulnar; and the foot, when it is first developed, has the plantar face directed inwards, and the instep in a contrary direction, so that the external, or fibular margin, is directed downwards, and the tibial upwards.

These principles furnish a very clear and satisfactory explanation of the manner in which the various degrees of defect of the upper and lower extremities, which have been enumerated, are developed. Thus, should the formative powers, which are concerned in the evolution of those parts from which the thoracic and abdominal members are formed, have these operations arrested, at any period previous to the fifth week after conception, the individual will be altogether destitute of any rudiments of extremities, as was the case in the monster described by Valisnieri; and a similar arrest of development taking place at any subsequent period, previous to that at which the different parts of the arms and legs are perfectly formed, will give rise to a defect of the parts corresponding to their state of evolution at the time at which the formative powers are interrupted. This accident, moreover, happening to the feet, before they have assumed that condition which characterizes them in their perfectly-formed state, explains the frequent occurrence of *club foot* in Acephalous and other *monsters of defect.*

§ 6. *State of the Abdominal organs in Acephalous monsters.* a. *Organs of Digestion.* The extent to which the abdomen may be defective has been already shown, and from the cases which have been reported, we are authorized to conclude, that if that cavity is ever entirely absent, such a condition must be exceedingly rare; the example reported by Ruysch being the only one in which some portion of it did not exist. The same observation may be applied to that portion of the alimentary canal which occupies the cavity. Though frequently imperfectly developed in Acephalous monsters, there are but few cases in which some portion of it does not exist. It may, indeed, be regarded as constituting, to a certain extent, a fundamental condition of the organism; and in some of the inferior animals, as the polypi, medusæ, &c., it forms the only part which is very distinctly manifest. Whenever, therefore, the formative powers are sufficiently energetic to form any portion of the abdomen, it seldom happens that some portion of the corresponding organs is not simultaneously developed.

It has been proposed by Breschet, (*Dict. de Méd.* I. 264,) to divide these organs into diaphragmatic or gastric, pelvic, and those which occupy the space between these two regions. Of these, the two first portions are more frequently defective than the third, or umbilical portion, which, being first formed, is least liable to an arrest of development.

The alimentary canal, which has been shown by the observations of Wolff, Oken, and Meckel, to be formed by the umbilical vesicle of the ovum, consists of several portions, which, during the early periods of its development, are separate and distinct. Of these, the inferior portion, which has been denominated by Oken, the *Anal* portion, is seldom entirely wanting; while the superior, or stomachal, is very frequently either partially or completely defective in those cases in which

the abdomen is imperfectly formed. Under these circumstances, the portion of the intestine which may happen to exist, terminates above, in a blind extremity; the point at which this termination takes place, corresponding to the portion of the canal which may be wanting.

In most of those cases in which the upper portion of the abdomen is deficient, the stomach or some of its parts are also absent. That organ was entirely defective in the examples of Acephalous fœtuses reported by Lecat, Mery, Isenflamm, Cooper, Zagorsky, Winslow, Gourraigne, Superville, Buettner, Gilibert, Odhelius, Monro, Lamure, Busch, Meckel, Malacarne, Atkinson, Hayn, Tiedemann, and others. Klein found a small imperfectly-formed stomach, situated in the upper and left part of the abdomen, and the œsophagus terminating in a blind extremity: in Curtius's case, the œsophagus descended to an elongated pouch filled with a watery fluid, which, on a level with the intestines, terminated in a blind pouch. Vogli merely found a rude, formless stomach.

There is also, in some cases, a defect of some portion of the small intestines: and it not unfrequently happens, that those parts which are formed are contained within the umbilical cord. Indeed, it is manifest, from what has already been stated, relative to the development of the alimentary canal from the *vesicula umbilicalis*, that there must be a period in the development of the fœtus, at which the intestines are contained within the cord: and if an arrest of evolution should occur while they are in that situation, the individual would present the condition usually denominated *congenital umbilical hernia.*

This was the condition of those parts in the cases reported by Atkinson and Meckel, and in four of those published by Tiedemann. Several other examples of the same kind exist on record, in most of which there were indications of a suspension of development in other parts of the body.

It is, however, difficult, in many cases, to determine what portion of the intestine is defective, the deficiency being merely represented by a preternatural shortness, and an imperfect evolution of the tube. In Odhelius's case, the intestine was unusually small in relation to the size of the body; and Klein and Everhard found it very short, and with but few convolutions. In the case reported by Cooper, notwithstanding the child was of the usual size, the intestine was only about six or seven inches in length; and in Monro's case, it merely measured seventeen inches. In the monster described by Gourraigne, which was only eight inches and a half long, the intestinal canal measured eight inches; and in an acephalous fœtus of the eighth month, described by Superville, it was only two feet long.

In a majority of instances in which the upper portion of the abdomen is defective, the *Anal portion* of the intestines, or that part of the canal which is composed of the inferior portion of the ileon, the cœcum, colon and rectum, is alone developed, and very frequently even some part of it is defective, or imperfectly formed.

Everhard observed a small portion of the larger intestine without a vermiform appendage, which terminated above and below in a blind extremity. In one of Meckel's cases, the body of the fœtus was merely six inches in length, and was traversed by an intestine of uniform magnitude, which terminated above by a blind extremity, and was of the same length as the body. A similar condition was observed by Cooper, Mery, Winslow, Sue, Gourraigne, and Zagorsky. The intestine also presented the same calibre throughout, in the cases examined by Buettner, Heuermann, Prochaska, Clarke, and Malacarne.

It frequently happens, however, that attached to the upper extremity of the large intestine, there is a small portion of the inferior extremity of the ileon; a fact of considerable importance, as furnishing a strong argument in favour of the opinion advanced by Wolff and Meckel, relative to the mode of formation of the intestines from the *vesicula umbilicalis.* Cases of this kind have been reported by Mery, Odhelius, Gilibert, Monro, Superville, Lecat, Meckel, Isenflamm, Busch, Atkinson, and Tiedemann.

But even where the greater part of the *anal* portion is developed, it frequently happens that the vermiform appendage of the cœcum is absent. This is satisfactorily explained by a reference to the laws which regulate the development of the alimentary canal. Thus, it has been shown by the researches of Meckel, that this process is not formed until about the ninth or tenth week after conception, at which period it first makes its appearance in form of a small tubercle, which gradually increases in length. Oken, however, considers it as the remains of the connexion which exists between the intestines and the umbilical vesicle during the early weeks after conception, but which becomes de-

tached at the period at which the intestines enter wholly into the cavity of the abdomen. According to either of these hypotheses, it will be seen, that should an arrest of development occur previous to the expiration of the ninth or tenth week, or the time at which the intestines, according to OKEN, become detached from the umbilical vesicle, to pass from the sheath of the cord, by which they are at first surrounded, into the cavity of the abdomen, the canal will present no traces of a vermiform appendix. This condition was observed in the cases reported by EVERHARD, HEUERMANN, BUETTNER, MALACARNE, COOPER, PROCHASKA, in one of those examined by MECKEL, and in the first example reported by TIEDEMANN. In all the other cases, in which the corresponding portion of the intestine was formed, the vermiform appendix existed.

Even when the whole extent of the anal portion of the intestine is formed, it not unfrequently presents some defect in its condition, either consisting in a limited or extensive *Atresia*, or closure, of the tube, or some anormal communication between it and some neighbouring organ. A state of atresia of the rectum, of variable extent, is a very common occurrence in acephalous and other monsters, and affords an indication that the acts of the formative powers which are concerned in the evolution of that organ have been interrupted, while it still remains in a rudimentary condition. Indeed, during the first five or six weeks after conception, the caudal extremity of the fœtus does not exhibit any opening which corresponds to the anus, which only becomes manifest about the seventh week, by a gradual development of the anal extremity of the intestine from above downwards, from the point at which it is connected with the umbilical vesicle, as already explained. Any arrest of development, therefore, taking place before this degree of evolution is consummated, must necessarily have a defect in the inferior portion of the tube, which is generally represented by a closure of its cavity. The intestine was in this condition in the cases reported by LECAT, EVERHARD, MONRO, LANKISCH, and PROCHASKA; and in one of the cases reported by TIEDEMANN, the rectum and vagina terminated in a kind of common *cloacus*—a condition which represents the original type of these organs, which, at the period of their first formation, constitute merely one common cavity.

In MONRO's case, the intestine opened in the bladder, and in those of DAUBENTON, KIRSTEN, BOUSQUET, and ALIX, it communicated with the vagina. (BRESCHET. *Dict. de Méd.* I. 267.)

Another feature of considerable importance, in the condition of the intestines in Acephalous monsters, is the frequent occurrence of small lateral appendages, denominated *diverticuli.* The development of these processes has been differently explained by physiologists. MECKEL, however, has offered an explanation which seems satisfactory in relation to this point. It has already been stated that the intestines are formed by the vesicula umbilicalis; that in their rudimentary condition they are attached to this vesicle, and are contained, for the most part, in the sheath of the umbilical cord; and that, in proportion as the development advances, they are detached from the vesicle, and pass wholly into the cavity of the abdomen. MECKEL, then, supposes, that these diverticuli correspond to the original point of attachment between these parts, and merely consist of the remains of that connexion, which, during the first weeks after conception, exists between them, rendered more conspicuous by the intestine being retained in the umbilical cord beyond that period at which it usually passes into the abdomen. This view of the subject, which is supported by many arguments deduced from the laws of the development of the fœtus in man and animals, is also adopted by TIEDEMANN, who cites in support of it two cases, in which the intestine was placed in the umbilical cord, where it presented the appearance of an elongated *diverticulum*, terminating in a point. MECKEL has likewise reported a case in which the small intestine terminated above in two blind portions, which presented a bifurcated arrangement, one portion of which, larger than the other, was manifestly the extremity of the intestine, while the second constituted a kind of *diverticulum.* These diverticuli have been observed by TIEDEMANN in some aquatic birds, the intestines of which are formed from the *membrana vitellina;* a part of which has been shown by modern researches to be identical with the umbilical vesicle of man and the mammalia.

The arrest of development is not always confined to the intestines: there is frequently a corresponding deficiency of the membranous duplicatures by which those organs are attached to the abdominal cavity. Thus, in one of the examples reported by PROCHASKA, and in SUPERVILLE's case, the mesentery was entirely deficient. GOURRAIGNE, CURTIUS, and KLEIN, found the intestines attached to the vertebra by means of cellular tissue, and in the first

two of these cases, they were all united into a common mass, by a membrane. In the case observed by Odhelius, the intestines were also invested by a membranous sac. The results furnished by these cases, prove that the mesentery does not exist during the early period of the development of the fœtus, but that the intestines are at first covered by a kind of membrane attached to the anterior face of the bodies of the vertebra, which, by becoming elongated, in proportion as the tube increases in volume, forms several duplicatures, between which that organ is included.

The intestines have seldom been found to contain any thing but the common mucous secretion which is poured out by their lining membrane. The meconium has only been observed by Gilibert, Odhelius, and Buettner. In the latter case, however, it was confined to the large intestines, the upper portion of the tube merely containing a small quantity of mucus.

The liver and the pancreas being dependencies of the portion of the alimentary canal upon which they are engrafted, are always wanting when that part of the tube is not developed. The liver and spleen were entirely wanting in the cases reported by Lamure, Monro, Gourraigne, Mery, Superville, Isenflamm, Buettner, Vogli, Winslow, Gilibert, Odhelius, Cooper, Zagorsky, and Lecat. In Klein's case, the liver seemed to be united with the right kidney. Curtius found a small irregular rudiment of the liver, without vessels or nerves, occupying the curvature of the stomach; and that gland presented a similar defect in one of the cases reported by Meckel. Katsky found the liver unusually small; and in Atkinson's case, it was divided into two lobes, and was surrounded by a kind of membranous sac.

But even when the liver exists, there is frequently an absence of the gall bladder. This vesicle was wanting in the cases reported by Everhard, Atkinson, and Meckel; a fact which proves that the defect of the liver is owing to a suspension or arrest of development, inasmuch as the gall bladder is not formed until about the fourth month after conception.

The case reported by Schelhammer affords the only instance in which the spleen existed; and in all the examples which have been reported, the pancreas was wanting, except in those of Klein and Gilibert. In the first of these, there was a small irregular mass adhering to the duodenum, which was supposed to be the rudiment of that gland.

These conditions of the alimentary canal, as has been remarked by Meckel, are interesting, as indicating a similarity of that apparatus to its condition in many of the inferior animals, in which no liver, spleen, or pancreas exist. The intimate adhesion of the intestines to the walls of the abdomen, also represent the disposition of the parts in the polypi and annelides, in the first of which, the internal surface of the skin constitutes the alimentary canal, while in the latter, the tube is so intimately connected with the skin as to be with difficulty separated.

b. *Urinary Organs.* The defect of development which characterizes the urinary apparatus, may involve a partial or entire defect of some of its parts, or some deviation from its normal type. The kidneys were properly formed in the cases reported by Mery, Schelhammer, Winslow, Vogli, Superville, Monro, and Busch. In the observations of Heuermann, Everhard, Lecat, Prochaska, Buettner, Moreau, Clarke, Cooper, Henkel, Odhelius, Gilibert, and Sue, they were entirely wanting. In some instances, the two kidneys have been found united. This condition was observed by Winslow, and in three of the cases examined by Meckel. In Winslow's case, the organs presented their concavity downwards, and only had a single pelvis, from which two ureters took their origin. In those reported by Meckel, however, there were two pelves, each of which sent off its ureter in the usual manner.

This fusion of the two kidneys is interesting, as demonstrating the original type of those organs. It has been shown by the researches of Wolff, Meckel, and Tiedemann, that during the early periods of the development of the fœtus, the kidneys form but a single gland, which, however, as the parts are more completely evolved, becomes gradually attenuated in the middle, and finally divides into two portions, the one corresponding to the right, and the other to the left kidney.

Curtius found the kidneys of the natural size. The right emulgent artery, however, originated by two branches, which united before they entered the gland; and the ureter, instead of coming off from the centre of the organ, took its origin from the anterior part of its inferior extremity. It nevertheless terminated in the bladder, at the usual point. In Zagorsky's case, the right kidney was larger than the left; and in the example examined by Gourraigne, they were unusually small, but exhibited their usual conforma-

tion. Lankisch and Monro found the ureters terminating before they reached the bladder. They were completely wanting in the cases reported by Lecat, Buettner, Odhelius, and Gilibert; and Klein remarks, that in the individual examined by him, the ureter of the left side was composed of three branches, while that on the right side was larger than the ileon.

The supra-renal capsules are seldom developed when the kidneys are defective; yet in Cooper's case, these bodies were partially formed, notwithstanding the kidneys were absent. They did not exist in the cases reported by Winslow, Monro, Vogli, Gourraigne, and Busch, and in two of those examined by Meckel. They were also wanting in the individuals examined by Odhelius, Gilibert, Lecat, Superville, Buettner, Clarke, and Henkel. Curtius, Isenflamm, and Meckel, found them in a state of imperfect development.

Odhelius, Everhard, Clarke, and Prochaska, found the bladder entirely wanting. In the cases reported by Buettner and Busch, it was remarkably small and contracted; and in the latter, the ureter opened into the vagina, immediately behind the hymen. Cooper found it almost without cavity: in Lecat's case, it did not present its usual pyriform configuration, and the urachus was pervious to the umbilicus. This tube was also open in Gourraigne's case, to within a small distance from the navel, and the coats of the bladder were thick, corrugated, and contracted. The persistance of the urachus, under these circumstances, shows the original connexion which exists between the bladder and the *allantoid* membrane of the ovum, which forms this portion of the urinary apparatus, in the same manner that the *vesicula umbilicalis* develops the intestines. Indeed, during the first periods of formation, the urachus and bladder merely represent a simple tube continuous with the allantoid, and it is only after the evolution of the organs has considerably advanced, that the portion which corresponds to the bladder begins to expand, and that the urachus becomes impervious by an obliteration of its canal. An arrest of development, therefore, taking place before these changes are effected, will leave the urachus and bladder in the condition which they present during the first periods of their formation.

c. *The Generative, or Sexual Organs.* In acephalous monsters, various modifications of the genital organs are produced by the same defect of development that implicates other portions of the system. These organs are sometimes altogether deficient: they are frequently deficient in some of their parts, and, besides, present numerous modifications in their form and connexions. No genital organs existed in the cases examined by Zagorsky, Clarke, Odhelius, Prochaska, and Atkinson, and in two of those reported by Meckel. Gilibert found merely the clitoris and nymphæ, without any uterus; and in Isenflamm's case, the external female organs were formed, but no indications of the internal parts could be observed. Gourraigne's case had a penis, but no testicles; and in the one reported by Buettner, the testicles were wanting, the penis was remarkably small, the spongy substance of the urethra was deficient, and that canal was open upon its lower part. Superville merely observed the right testicle, which was situated in the lumbar region: Monro found only the left, occupying its natural situation, and the urethra open to a small extent, between the bladder and the glans penis. In one of Meckel's cases, one of the fallopian tubes was larger than the other: Cooper found the uterus properly formed, but no ovaria; and Klein, the cavity of that organ very large, while its walls were remarkably thin. In the individual described by Buettner, the external organs were well formed, but the vagina represented a simple, short, oval cavity, at the bottom of which there were two small excavations, from each of which a small canal took its origin, which, after passing a short distance, terminated by a blind extremity in the neck of the uterus. The eustachian tubes were double at the point at which they were attached to the uterus, but single at their outer extremity, where they presented an abdominal opening, and were connected with an imperfect ovarium. Curtius found the male organs perfectly formed, as did also Lecat, and Winslow. In Curtius's case, however, the spermatic artery took its origin from the substance of the kidney. In one of the cases described by Meckel, there were two testicles, both of which were placed on the same side: the other parts of the genital organs were naturally disposed. In another example reported by the same individual, and in one observed by Monro, the rectum communicated by a small opening with the urethra.

It is somewhat remarkable, that a large proportion of Acephalous and other monsters are of the female sex. This fact, long since noticed by Morgagni, has been fully confirmed by the subsequent observa-

tions of Sœmmering, Meckel, Otto, Autenreith, Tiedemann, Breschet, and others, and furnishes an interesting topic for investigation. Out of ten monstrous fœtuses described by Sœmmering, eight were females. Otto states, that of nineteen Acephalous monsters preserved in the museum of the university of Berlin, seven only exhibit evidences of the organs which characterize the male; and out of four, which he has himself described, three were females. Tiedemann also observes, that in fifty-one monsters, preserved at Berlin and in another cabinet, only sixteen are of the male sex. Sœmmering has, moreover, shown that in a large majority of abortions, where the ovum is thrown off at a very early period after conception, the embryo is of the female sex; and out of fifteen embryos of the first month, described by Autenreith, not more than six were males. (Breschet. *Dict. de Méd.* I. 281.)

A careful observance of the transitions to which the ovum is submitted during the different periods of its development, will afford a rational and satisfactory explanation of this phenomenon. It has been demonstrated by the observations of Meckel, that the fœtus passes, between the period at which conception takes place, and that at which the different parts of the new being assume their perfect development, through a regular succession of conditions or stadiæ, each of which represents the type of some of the inferior animals, the primitive stadia corresponding to the type of those animals the organization of which is most simple, and each subsequent one similating itself to the characters of some individual which occupies a higher station in the scale, until, by a series of changes, by which the organs gradually become more perfect and complex, it finally attains that state of complete evolution by which it is characterized when it is fully formed. Comparative Anatomy, moreover, explains, that all those animals which occupy the lowest rank in the scale of animal creation are exclusively of the female sex, there being no male organs provided for the purpose of fecundation. Even in the Acephalous moluscæ, we only find an ovarium concerned in the process of generation, those animals possessing no distinct male organs. It is only at a more elevated point in the scale that these latter organs become distinct, and even here, in a considerable number of animals, the two sexes are blended in the same individual, and only become distinct in such as are more perfect in their organization.

An examination of all these facts seems to demonstrate, that throughout the whole range of animated nature, the condition of the sexual apparatus of the embryo, when it first makes its appearance is that which characterizes the female; that in the lowest orders of animals it retains this condition throughout the entire period of existence, and that in those which are more perfect in their organization, it only acquires the attributes of the male by a regular series of transitions, by which the different parts are more fully and perfectly evolved. This seems to be the case with the human embryo, which, as the facts stated above show, always presents the characters of the female during the first weeks of its development; those which characterize the male being only acquired at a later period. This view of the subject has been ably sustained by Meckel and Tiedemann, and has also been espoused by Breschet. Ackermann and Autenreith, however, suppose, that the genital organs, when they first appear, present neither the characters of the female or the male, but occupy an intermediate condition, which gradually assumes the one or the other, according to the direction given them by the formative powers. The researches of Tiedemann, nevertheless, prove, that at the period at which they first become manifest, they are always female. He has stated that no external genital organs are manifest before the fifth week after conception. During the whole of this period, the fœtus presents no opening corresponding to the anus, the mouth, or the ears. About the expiration of the fifth week, or the commencement of the sixth, an opening is formed for the anus and genital organs, in front of which a small tumour or prominence becomes gradually developed. About the seventh or eighth week, this small body assumes the form of the clitoris, and is traversed upon its lower surface by a minute groove, which leads from the anus. By the ninth week the clitoris is more perfectly formed, and its extremity is surmounted by a glans, which corresponds to the opening of the genital organs: the labia also begin to appear about this period; and about the tenth or eleventh week, the vulva is separated from the anus by a small transverse band. The labia are now larger and more distinctly developed, and they, as well as the nymphæ, cover the clitoris. During the fourteenth week, the cleft of the genital organs becomes transformed into a prominent line, which finally forms a raphe; and the labia, by uniting with each other, give

rise to the scrotum, which is not as yet occupied by the testicles. The clitoris also presents a cleft at this period, which occupies its inferior surface, and extends forwards to the glans. From the fifteenth to the end of the sixteenth week, the raphe already adverted to, does not, in the male fœtus, merely unite the labia, but also the prominent borders of the groove which ranges along the inferior surface of the clitoris, so that these parts, together with the nymphæ, by becoming thus united, form the male urethra. By subsequent changes this rudiment, which is thus traversed by a urethra, and supplied with a prepuce, acquires all the characters of the penis—and about the eighth month the testicles descend into the scrotum. (Breschet, *Loc. Cit.*)

In those individuals who remain females, the genital organs retain the condition, at least the conformation, which they present during the early periods of their formation. They undergo a change of volume, but their form experiences but trivial alterations. The principal difference, therefore, between the two sexes is founded upon the more perfect evolution of the organs in the latter, manifested by a succession of transitions, by which the various parts, which constitute the female organs, gradually acquire that arrangement which characterizes the male sex. The characters presented by many monsters furnish arguments which go far to corroborate this hypothesis. Thus it frequently happens, that after the opening is formed which corresponds to the genital organs and anus, and the clitoris has made its appearance, the parts experience an arrest of development; the labia and nymphæ do not unite with each other to close the opening, but the clitoris continues to increase in volume, so that the individual presents the appearance of being endowed with both sexes, or that condition which has been denominated *Hermaphrodism.* Where the development of the parts has advanced a step beyond this point; where the labia have become united so as to close the greater part of the *genito-anal* opening, but not the whole extent of the groove which ranges along the inferior face of the clitoris, or, in other words, the rudiment of the penis, and an arrest of development takes place; the penis will be formed, having a portion of the urethra defective or open upon its inferior surface, constituting the condition denominated *Hypospadias.* The penis also experiences other vices of conformation; as a cleft of the glands, a defect of one of the cavernous bodies, &c.; all of which represent the type which characterized the parts at some period, while they were in the act of undergoing those changes by which the sex becomes changed from female to male.

There are, moreover, many circumstances which render it probable that the internal organs of generation are always female, during the first periods of development. The ovaria correspond with the testicles, the prostate gland to the uterus, and the vas deferens and vesiculæ seminales to the fallopian tubes. The testicles, like the ovaria, are at first situated in the cavity of the abdomen, and are, like them, also contained in a duplicature of the peritonæum, which connects them with the prostate gland, in the same manner that the ovaria are attached to the uterus by means of a similar duplicature, denominated broad ligament; and, to complete the similitude, the urethra, in the male, may be compared to the vagina:—a similitude which is fully justified by the facts already stated relative to the development of these parts.

§ 7. *Condition of the circulatory apparatus in Acephalous monsters.*

The examination of the organs of circulation, as they exist in the form of monstrosity under consideration, is capable of eliciting many valuable facts and principles in relation to the development of the fœtus, and will demonstrate, contrary to the opinion of Harvey, Haller, and others, that the presence of the heart is not essential to insure the formation of the organs, inasmuch as many of them are frequently found perfectly evolved where that organ itself does not exist. Indeed, in nearly all the examples of Acephalous monsters which have been reported, the heart was absent; yet this circumstance did not prevent the development of other organs, which existed in different degrees of formation, some of them being defective, while others were perfectly formed. Elben has described seventy-two examples of Acephalous monsters, in all of which the heart was absent, and he considers that defect as a constant characteristic of that variety of malformation.

The only cases in which the heart was observed, were those described by Katsky, Gilibert, Serres, and Vallisnieri, and even in these it was imperfectly formed. In Gilibert's case, it was fleshy, and was divided into auricles and ventricles. There were two separate openings communicating with an elongated canal, which descended into the abdomen, and which corresponded to the inferior portion of the

aorta; but the superior branches of that vessel were wanting. In the individual examined by Katsky, the heart was also muscular, and was composed of two auricles, one situated above the other: the aorta and vena cava also existed. Zagorsky found the situation of that organ occupied by a solid mass, from which the vessels took their origin; and in one of Prochaska's cases, there was a soft body situated between the two layers of the mediastinum, from which the rudiment of a vessel resembling the aorta ascended a small distance, and then took its course downwards, but which could not be injected, or traced far from its origin.

The arrangement of the vessels is variable in different individuals. It has been stated by Schelhammer, that they were entirely wanting in the case which he examined. Meckel has remarked, however, that this conclusion was probably formed from a superficial examination, inasmuch as in the individual observed by Odhelius, the umbilical cord did not enter the cavity of the abdomen, but lost itself in the common cellular tissue. In Buettner's case, the arteries were altogether absent. The umbilical cord only contained a single vein, which sent branches to the intestines, the thorax, and the rudiment of the head. There was neither aorta, vena cava, or any of the branches of these vessels. Lamure, also, found an umbilical vein merely, which opened into the ascending vena cava, below the kidney. This latter vein extended along the bodies of the vertebra, and formed two branches, which probably corresponded to the sub-clavian veins. In one of Winslow's cases, the umbilical cord was attached to the small rudiment of the head, which occupied the upper portion of the trunk of the body, where it communicated with a vessel which descended in the usual direction of the aorta, and divided into several branches. Poujol found the umbilical vein opening into the vena cava, but no traces of either aorta or umbilical arteries. In Mery's case, there were two large vessels situated upon the anterior part of the vertebra, one of which was the aorta, the other the inferior vena cava. The umbilical vein sent branches to the mesentery, whence the trunk of the cava received its blood, which it poured into the aorta. Lecat found both arteries and veins, and he observes, that the artery seemed to be directly continuous with the umbilical vein. To describe the manner in which the circulation was carried on, he supposed that there was an anastomosis between the artery and the vena cava, and that the latter also communicated with the umbilical vein. Cooper states, that the umbilical vein, directly after its entrance into the cavity of the abdomen, divided into an ascending and a descending branch, each of which sent off numerous ramifications. These two branches represented the ascending and descending aorta, which lost themselves in small branches, and sent off below the umbilical and iliac arteries. The vena cava also existed, but it is not mentioned that it had any communication with the aorta. The injection, however, which was thrown into the umbilical vein filled the aorta and its branches. Monro observed that the umbilical vein divided into several branches, directly after its entrance into the cavity of the abdomen, which were distributed to the several organs, where they were accompanied by corresponding branches of the umbilical arteries. There was also a vessel connected with these last, which represented the aorta. There was no vena cava, so that the artery had to perform the double office of artery and vein. In Gourraigne's case, the umbilical cord contained two arteries and a vein. The vein divided into two main branches, one of which passed to the right, and the other to the left. These branches descended towards the pelvis, and divided into numerous ramifications, which supplied the abdomen and pelvis, and the inferior extremities. The umbilical arteries followed the course of the vein, so that, there being neither aorta nor vena cava, the circulation must have been carried on by the blood passing from the umbilical vein into the corresponding arteries, by which it was conveyed back to the placenta. Klein observed a vessel, which he supposed to be an artery, situated within the pelvis. The trunk communicated with several small vessels which resembled veins. The internal and external iliacs, and the femoral arteries, were larger than the aorta, which, above the point at which the iliacs were given off, was found to diminish in volume, as it was traced upwards. It gave origin to three lumbar, one mesenteric, three emulgent, and eight intercostal arteries, and finally terminated above in two branches, which ranged in an oblique direction, and divided into the subclavian and carotid arteries of each side. The umbilical arteries had their ordinary arrangement. In the case reported by Curtius, the umbilical vein, after it had entered the abdomen, divided into two branches, which again united, but could not be followed beyond the point of their union. The aorta divided at its lower extremity as usual, but above, it sent off seven

branches, which anastomosed freely with each other. There was no vein perceptible within the cavity of the thorax, but the circulation was doubtless carried on by a communication between the umbilical vein and the aorta. There were both arteries and veins in the extremities. Clarke, and, in one case, Tiedemann, found only the umbilical vein, and one umbilical artery, provided for the maintenance of the circulation. The vein ramified in the abdominal organs, and formed there an anastomosis with the artery.

The portal system is always wanting in Acephalous monsters;—a condition which, as has been remarked by Meckel, is interesting, as showing the close similitude of their vascular system to that of many of the inferior animals; as, for example, the molusca, which are destitute of those vessels. There is, moreover, a strong resemblance between the arrangement of the vessels which was observed in the different cases referred to above, and that which exists in the arachnides, crustacea, and, according to the recent observations of Carus, the insects in which the circulation is carried on by a simple vascular trunk, branched at its two extremities, which is entirely destitute of any organ corresponding to a heart.

With such a defect of the ordinary apparatus of circulation;—with an entire absence of the heart, and likewise, in many instances, of the vena cava and the aorta, it may be asked, how the circulation of the blood is carried on in Acephalous monsters? Upon this point, various conjectures have been offered, founded for the most part upon the particular condition of the vessels observed by the individuals who have ventured to speculate upon the subject. Poujol, who asserts that in his case there were no vessels but a single umbilical vein, opening into the vena cava, without any aorta or arteries to return the blood to the placenta, conceived that the circulation was carried on in the same manner as in plants. The analogies furnished by some animals would, indeed, seem to countenance such an inference; for in many of the inferior orders, there is but a single order of vessels branching out into every portion of the organism, by which the nutritive fluids are conveyed to their point of destination, and those particles which are not consumed by the vegetative acts of the tissues are again received, together with the other elements which are derived from the organs themselves, to be conveyed back into the system of circulation. There is no heart, or any other organ of impulse, except the vessels themselves, which are nevertheless endowed with sufficient elasticity or contractility to propel the fluids through the numerous streamlets which are destined for their conveyance, the direction in which these fluids are carried varying according to the order in which the vessels act. Thus, in the insect, it has been shown by Carus, that there is an elongated vessel which traverses the body of the animal in the vicinity of the back, which performs the office of circulation, although there is no heart or agent of impulse except the tunics of the vessels. The fluids, therefore, do not seem to move in a circle, but merely to fluctuate in the course of the vessel. Inasmuch, however, as these vascular arrangements terminate at their extremities by an arborescent subdivision, consisting of numerous ramulæ which anastomose freely with each other, is it not probable that fluids may be carried out by a portion of these capillary vessels, and be poured by them into the others, by which they are conveyed back to the main trunk, which, under these circumstances, would perform the office of a heart? If this explanation be admissible, there would be a double capillary circulation, one at each end of the main trunk of the vessel, while the latter would constitute the centre of the circulatory system.

In one of the cases reported by Winslow, there was an arrangement of the vessels exactly the reverse of that observed by Poujol: there were arteries, but no corresponding veins. He therefore supposed that the umbilical vein, which communicated with the aorta, conveyed the fluids which it circulated to that vessel, by which it was sent into its numerous capillary ramifications, where it was thrown into the parenchyma of the tissues instead of into the veins, which being rendered thereby full and turgid, allowed a part of it to escape, in form of an exhalation, through the pores of the skin. It should be stated, however, that the vessels contained no blood, but merely a small quantity of a thin lymphatic fluid.

But while these conditions, which were observed in the examples first referred to, render it difficult to explain how a sufficient circulation to maintain the organization of the imperfectly formed fœtus could be carried on, it has been seen that in a large proportion of the instances described by authors, there were both arteries and veins, so that a solution of the problem is very much facilitated. Still, however, they have not agreed in their explanation of the phenomenon of the circulation even under

these circumstances, and have attempted to account for it on principles altogether at variance with each other.

The heart being absent, it was affirmed by Mery and Lecat, that the blood is circulated through the vessels of Acephalous fœtuses by the impulse communicated to it by the heart of the mother:—a fact which Mery adduced in support of the opinion that there is a direct continuity between the maternal and fœtal vessels in the placenta. It may be remarked, however, that this communication has never been satisfactorily demonstrated, and although a few isolated facts have been observed which give a semblance of probability to the opinion which advocates its existence, it has been denied by a large proportion of physiologists. Breschet states, that he had repeatedly sought for it in vain, and we know that in oviparous animals no such communication exists, yet vessels are developed during the period of incubation, and a kind of circulation is established before the heart is properly formed.

The most satisfactory conjectures upon the subject are those offered by Monro and Tiedemann, which though directly opposed to each other, are both corroborated by several facts.

According to the opinion of Monro, the blood is conveyed from the placenta to the fœtus, by the umbilical vein; and the ramifications of this vein performing for the fœtus the office of an artery, circulates the blood to every part of the body, where it passes from the venous into the arterial capillaries, and is from thence conveyed back to the placenta by the umbilical arteries. According to this view of the subject, the veins, which convey the blood to every part of the fœtus, and execute the acts of nutrition, perform the office of arteries for the fœtus, and veins for the placenta; while the arteries which return the blood from those points, represent veins for the former, and arteries for the latter. So far as the umbilical vein is concerned, this explanation accords with the natural order of the circulation in the properly formed fœtus; yet it has been urged as an objection against its validity, that as the veins of the body of the fœtus possess valves, the blood cannot be circulated against them.

Tiedemann supposes, in opposition to the sentiment of Monro, that the umbilical arteries are the instruments by which the blood is conveyed from the placenta to the fœtus;—that by the anastomosis which exists between these vessels and the fœtal veins, the fluid passes into the latter, by which it is conveyed to the umbilical vein, and by that vessel back to the placenta, thus performing a complete circle. The umbilical arteries, therefore, perform the office of veins for the placenta, and that of arteries as regards the body of the fœtus; the veins of the latter performing their usual office, while the umbilical vein has the relations of an artery with the placenta. This ingenious hypothesis, though at variance with the natural order of the fœtal circulation, is nevertheless, as has been stated by Breschet, (*Loc. Cit.* p. 277,) corroborated by an appeal to comparative Anatomy. Thus, in many of the inferior animals, a venous trunk is seen anastomosing with one of an arterial character, which ramifies, after the manner of arteries in general, in different parts of the body; and the venous radicles, which take their origin from this source, are again collected into one main trunk. In the gasteropode molusca, as, for example, the Doris, Tritons, the Aplysiæ, Helices, Limaces, &c., all the veins of the body are collected into two venæ cavæ, which are distributed to the apparatus of respiration. In the fishes, moreover, which merely have the sinus of the vena cava and the right auricle of the heart, the artery which takes its origin from the latter, and which carries the venous blood, divides and subdivides so as to form a delicate plexus of vessels in the gills of the animal, in which the blood becomes oxygenated, and is from thence conveyed back, by several branches, to the trunk of the aorta, by which it is distributed to every part of the body. In these cases, the veins of the gills pass directly into the aorta, without the interposition of any sac or auricle between the trunks of the two vessels;—an arrangement which is also observed in the vena porta and hepatic veins of the liver in man, the mammalia, and birds; the portal veins which convey the blood to the liver, and perform the office of secretion, corresponding to one artery, while the hepatic veins, which carry the blood from that organ, have the usual relations of veins in other parts of the body.

These principles are also supported by the phenomena which are observed during the development of the fœtus. In the embryo of birds, the veins are the first vessels that are formed; and according to the researches of Harvey, Wolff, and Pander, the first manifest indications of them become apparent about the second day of incubation, in form of two small isolated points, which gradually run together, become elongated in form of small channels or grooves, and finally assume the proper characters of veins, which are united in one

common trunk—the umbilical vein. The heart begins to appear about the third day, and is at first, according to Haller, a kind of elongated slightly flexuous canal, which communicates with the umbilical vein. This canal, by becoming gradually expanded, forms the anterior auricle of the heart, or the bulk of the aorta, from which the arteries are sent to every part of the body. Anterior to the development of the heart, the curvature of the vein, which takes place to continue with the trunk of the aorta, represents very well the nature of the communication between the arteries and veins in Acephalous fœtuses. (Breschet, *Loc. Cit.* p. 278.)

All these considerations prove, contrary to the assumption of Haller and others, that the heart is not the part which is first formed in the fœtus; neither can it be considered as the source of all the other portions of the organism, inasmuch as many parts are developed in Acephalous monsters in which that organ does not exist, and where the circulation is merely carried on by the agency of a few arteries and veins which have no centre of impulse, and no agent to propel the blood through them except the contractility and elasticity inherent in their tunics. The history of the development of the fœtus, moreover, the details of comparative Anatomy, together with the condition of the vessels observed in Acephalous monsters by Poujol and Winslow, show that in its simplest state, the vascular system consists of merely a single trunk, one extremity of which ramifies in the placenta, while the other branches out in the body of the fœtus;—an arrangement which resembles that of the portal system, and which is also imitated, as Meckel has correctly observed, in the new vessels which are developed in a false membrane, during the progress of its organization. In these cases, small isolated points of blood are at first visible in different portions of the gelatinous, homogeneous mass, which finally shoot, in form of radii, from the centre towards the circumference, these lines communicating with each other so as to form a branched or arborescent arrangement, consisting of the new vessels, which at a later period form communications with those vessels which pre-existed in the surrounding parts. Until the establishment of these communications, the condition of the vessels is precisely similar to that of the vascular system observed by Poujol and Winslow; but after the new set of vessels have formed a communication with the old, the vascular arrangement becomes more complicated and perfect,—is as it were double, and consequently resembles the most common type of the vessels in the form of monstrosity under consideration, in those cases in which there is no heart appended, but the circulation is maintained exclusively by the agency of the vessels.

It therefore follows, from all these considerations, that the various degrees of defect which are observed in the vascular system of Acephalous fœtuses, are the result of an arrest of development, taking place before the heart and the whole of the vessels are evolved, thus leaving those arteries and veins which are formed, in that simple state which characterizes their type during the earliest periods of their development.

But while these are the characters of the vascular system in Acephalous monsters, it should be remarked, that there is a question, at least as regards particular cases, whether these vessels circulate red blood, or merely convey a colourless fluid? In the case of Winslow already referred to, it has been stated that the vessels of the fœtus contained no blood, but a simple transparent lymph. The same absence of red blood was observed by Buettner, Schelhammer, Curtius, and in two instances by Meckel. In most of these instances, the vessels merely contained a small quantity of a thin colourless fluid. In the case reported by Curtius, however, it was slightly brown, and in Buettner's case, there was red blood in the placental extremity of the umbilical vein. Cooper found all the vessels occupied by red blood.

§ 8. *State of the respiratory system in Acephalous monsters.* The lungs and their appendages have been generally found wanting in Acephalous monsters. The examples reported by Vallisnieri, Gilibert, Salsmann, Isenflamm, and Prochaska, are the only ones in which the lungs existed, and even in these they were merely in a rudimentary condition. Thus, in Vallisnieri's case, the heart was situated between two membranous sacs, which were regarded as the commencement of the formation of the lungs; and Salsmann observed nearly the same arrangement. In Gilibert's case, these organs were properly formed, but were destitute of a trachea.

With the absence of the lungs and trachea, there is also generally a deficiency of the thymus gland. Cooper, however, found, in the situation of this body, three small glands, which, when examined with the microscope, presented the same structure as the thymus itself.

The respiratory organs of the fœtus are developed at a late period, and do not, ac-

cording to the observations of MECKEL, make their appearance until about the end of the second month after conception. The lateness at which they are evolved results from the circumstance that they are not necessary in the fœtal economy, and likewise explains how it is that they are very generally absent in Acephalous monsters, even where the heart exists.

The diaphragm is still more frequently absent than the lungs,—a condition which shows a striking analogy between the condition of the human embryo, during the early periods of its development, and the permanent type of a large proportion of the inferior animals, in which that muscle does not exist. SCHELHAMMER, SALSMANN, and ISENFLAMM, are the only individuals who have mentioned the existence of the diaphragm in Acephalous fœtuses. In ISENFLAMM's case, there was no opening for either the aorta or vena cava.

§ 9. *The nervous system of Acephalous monsters.* The upper portion of the cerebro-spinal axis of the nervous system is always absent in Acephalous monsters, the extent of the defect being variable according to the extent of the development of the trunk of the body. The brain and its nerves are absent in all cases, and the extent of the spinal marrow is generally in relation with the degree of evolution of the spinal column.

In the cases reported by RUYSCH, ODHELIUS, and BUETTNER, the spinal marrow was entirely absent, and CLARKE found neither spinal marrow nor nerves. GILIBERT states that the lower part of the spinal marrow was properly formed, but above, where it was placed within the three last dorsal vertebræ, it was attenuated, and did not give off any nerves. MONRO found the spinal marrow terminated above in a small point. There were coming off from it seventeen pairs of nerves of nearly their proper volume. GOURRAIGNE also observed the spinal marrow surrounded by its membranes. VOGLI states that the spinal marrow had its usual coverings, and that the spinal nerves also existed, and WINSLOW found the lumbar and sacral nerves given off as usual, but remarks that they were lost in the common cellular tissue, directly after they had escaped through the intervertebral foraminæ. In BUSCH's case, the spine terminated above in a small bifurcated prominence, in which there was a slight indication of the development of the brain. There were eleven pairs of nerves, which had large gangliæ. The three first mounted upwards; the two following in a transverse direction, while all the others descended. The sympathetic nerve existed in both abdomen and pelvis. SUE found the spinal marrow in the sacrum and the lumbar vertebra, but LAMURE merely observed, instead of that portion of the nervous system, a very slender vascular filament: the vertebral canal was unusually large. ISENFLAMM states, that in his case, the spinal marrow existed in both the abdominal and thoracic portion of the spine. There was only a single nervous filament distributed to the upper extremity, but the nerves of the abdominal members exhibited their normal arrangement. KLEIN found the vertebral canal filled with a red watery fluid, the nerves of the lower extremities properly formed, and a single filament coming off from the spine above the level at which the other nerves took their origin. In one of PROCHASKA's cases, the spinal marrow, as well as the lumbar and sacral nerves, were developed; and in one of the instances reported by TIEDEMANN, the same portion of the nervous system existed, together with the inferior portion of the sympathetic nerve, which formed the emulgent and hypogastric plexuses. In two other examples, described by the same individual, the gastric portion of the sympathetic nerve was developed, and its filaments followed the course of the vessels. HEUERMANN found the spinal marrow terminated above by a small round prominence, which he considered as the rudiment of the head, and several nerves were observed passing out in their usual order. In one of TIEDEMANN's cases also, the upper extremity of the spinal marrow exhibited a conical enlargement, which however was filled by a whitish-coloured diffluent material, similar in its characters to disorganized brain. LECAT, in like manner, found the rudiments of the nerves of the upper extremity inclosed in a watery vesicle. In three of MECKEL's cases, the spinal marrow of the trunk, together with its nerves, and those of the lower extremity, was developed. In one individual, however, the nerves and muscles of one of the lower extremities were deficient. In the first example, there was no indication of the sympathetic nerve within the cavity of the thorax, although the bones of that region were well formed: that nerve existed, however, within the abdomen. The spinal nerves were developed, but the right upper extremity received no filaments.

All these observations demonstrate, that a fœtus may be formed, not only with an entire absence of the heart and a considerable portion of the vascular system, but

also with a complete defect of the brain, the spinal marrow, and even a part of the nerves. In CLARKE's case, indeed, it is stated that all the nerves were wanting, but it is more than probable that some portion of the sympathetic or ganglionic nerve existed. Indeed, it may be considered as exceedingly questionable if that nerve is ever entirely deficient. True it is, that its presence was not noted in many of the cases which have been referred to above, yet the constancy of its existence in the instances examined by MECKEL and TIEDEMANN, together with its presence in the case reported by BUSCH, render it probable that it was not altogether deficient in any of the other cases.

Many conjectures have been offered in relation to the deviations of the nervous system which have been described, but some of them, which were merely founded upon the appearances exhibited by the brain in anencephalous monsters, have been demonstrated by both reason and observation to be utterly untenable. This is especially true of the hypothesis advocated by MORGAGNI, HALLER, SANDIFORT, ACKERMANN, and others, who supposed that the brain and other parts of the nervous system were originally formed, but were, during the evolution of the fœtus, destroyed by the development of hydrocephalus, and a subsequent rupture of the integuments of the cranium, admitting of an escape of the fluid,—by a wasting of the brain and the corresponding parts, and various other accidents of a similar nature, all, however, of an imaginary character, and entirely inadequate to explain the phenomena manifested by Acephalous monsters.

The defects of the nervous system, like those of all the other organs which have been examined, are attributable to an arrest or disturbance of the acts of the formative powers, taking place at some period between that of conception and that time at which the rudiments of the fœtal organs become modelled into their appropriate forms, and assume those relations which they have subsequently to maintain in the economy of the individual. In any given case, therefore, the kind and degree of the defect will correspond to the condition of the organism at the period at which it experiences an arrest of development, always being greater in proportion as such an accident occurs earlier after conception.

Satisfactory inferences upon this point, however, can only be deduced from an analysis of the phenomena which attend the development of the embryo, and the order in which they succeed each other.

The development of the nervous system, in oviparous animals, has been attentively investigated by numerous physiologists, and the facts elicited by these researches have greatly contributed to elucidate the changes which take place during the formation of the same system in the human embryo. By HARVEY, HALLER, MALPIGHI, and others, it was long since observed, that a short time after the heart makes its appearance, the rudiments of the brain become manifest in form of transparent vesicles filled with a limpid fluid. In the gallinacea, these parts become visible about the fifty-ninth or sixtieth hour of incubation, in a short time the vesicles become vascular, and the fluid gradually acquires a greater degree of consistency, so that, by the eighth day, it assumes the appearance of a diffluent mass, which constitutes the pulpy substance of the brain. According to some recent observations of DELPECH and COSTE, (*Annales des Sciences Naturelles.* XXV. 1832,) the first rudiments of the nervous centre consist of several concentric striæ, disposed upon the disk of the vitulline vesicle, which gradually become straight, and form two parallel longitudinal filaments, at first unconnected with each other, but which become united by a kind of commissure, and by subsequent changes form the spinal marrow. Similar observations have been made on the incubated egg by PANDER, (*Entwicklungsgeshichte des Hühnchens im Eie.* Wurzsburg, 1817,) and BAER, (*Repert. Gen. d'Anat. et de Phys. Path.* Tom. VIII. 1829.) The lateral cords, however, were considered by them as merely consisting of the rudiments of the vertebræ ; and BAER affirms, that towards the latter part of the second day, he always found the rudiment of the spinal marrow presenting the character of a simple tube, somewhat compressed upon the sides, and that in consequence of this tube being thicker in these latter situations, and continuing to increase in volume, it probably becomes divided into two portions, although primitively it only consists of one. These observations of BAER nearly correspond with those made by TIEDEMANN (*Anatomie du Cerveau,* p. 20.) upon the development of the spinal marrow of the human embryo. The researches of SERRES, however, led him to infer, that the central part of the nervous system is at first composed of two separate, parallel, longitudinal filaments, which, by a progression of the development, from the circumference towards the centre, unite upon the median line, in the manner

represented by Delpech and Coste, (*Anatomie Comparée du Cerveau.* Tom. 1. p. xxxix.) Be this as it may, it has been shown by the investigations of Coiter, Harvey, Stade, Langly, Steno, Malpighi, Haller, De Graaf, Breschet, Tiedemann, Pander, Meckel, and others, that the brain itself consists of an assemblage of transparent vesicles, corresponding in number to the different parts into which the organ is subsequently divided, but which are not all simultaneously formed. The fluid which those vesicles contain has its thickness and consistence increased, as the process of development advances, and finally becomes transformed into, or has its place supplied by, the proper cerebral substance. The evolution of the spinal marrow, however, always takes precedence of that of the brain; proving incontestibly the correctness of the opinion of Gall and Spurzheim, that instead of the spinal marrow being a prolongation of the brain, the former is always formed antecedent to the latter organ.

The investigations of Tiedemann prove, that in the human embryo, the process of development in the spinal marrow and the cerebral muscles, is considerably advanced before the expiration of the second month, at which time he could not observe any connexion between the nerves and either the brain or spinal marrow; a fact which proves that the nerves are formed independently of these great centres, and which may also be construed to militate against the opinion of Ackermann, who maintained that the brain is formed by the nerves, inasmuch as there are numerous examples of Acephalous monsters on record, in which, notwithstanding the nerves were formed, the brain was entirely wanting. Indeed, a case of a monstrous fœtus has been reported by Lallemand, (*Observations, Pathologiques*, p. 40. Paris, 1825,) in which the spinal marrow was entirely wanting, yet the nerves existed; and this fact, together with many others, may be considered as conclusive in favor of the hypothesis, of Serres, who maintains that the peripheral portion of the nervous system is always formed before its centre, and that they only become connected, in proportion as the latter is developed.

An application of these principles will enable us to explain the various degrees of defect which have been observed in Acephelous monsters; for it must be apparent, from what has already been stated, that should any circumstance transpire to interrupt the acts of the formative powers, at any period before the individual parts of the nervous system have assumed their appropriate form, such parts will remain in the condition in which they were when the accident occurred, and a corresponding defect will be the consequence. Thus, should this arrest of development take place before the peripheral portion of the nervous system is formed, there will be an entire defect of the whole of the cerebro-spinal nerves, together with their centres, as was observed in Clarke's case: and between this degree and that which is so slight as merely to consist of an absence of the brain, there are various intermediate conditions, all corresponding to the particular juncture at which the evolution of the parts becomes interrupted.

A question here presents itself, however, which deserves a passing notice. What influence does the cerebro-spinal system of nerves exercise over the development of the organism, and is its presence indispensable to insure the regular evolution of the different parts of the fœtus? and if not, is it possible for the organs to be evolved, when there is also an absence of the ganglionic nerves?

That the presence of either the brain or spinal marrow is not an indispensable condition in the development of the fœtus, is sufficiently proved by the several cases which have been reported, in which both those organs were wanting. Had they ever existed, it would be impossible for them to be so completely destroyed by either hydrocephalus or atrophy, as to leave no vestiges of either their own structure, or of their envelops;—a condition which, as has already been shown, was observed in several cases, and especially in those of Ruysch, and Clarke. These examples, taken in conjunction with others in which there was an entire absence of the brain and spinal marrow, reported by Morgagni, Kerkringius, Wepfer, Littre, Sue, Fauvel, Mery, Lallemand, &c., prove, moreover, that the hypothesis of Morgagni, Haller, Sandifort, and Ackermann, already adverted to, and which was at one time maintained with certain modifications by Beclard, is altogether inadmissible. Such an extensive destruction of parts could never result from a mere hydrocephalus, or process of atrophy;—no accident to which the fœtus is exposed, during its development, could so completely annihilate these organs after they had been formed; and the whole of the phenomena exhibited by Acephalous monsters constrains us to believe, that the defect of the nervous system, like those of the other organs observed under similar

circumstances, is purely the result of an arrest of development taking place in the parts concerned, before they have attained their normal conformation. That the brain and spinal marrow are not necessary to insure the development of the fœtus, may, moreover, be inferred from the phenomena observed by MERY, (*Hist. de l'Acad. Roy. des Sc.*, 1712,) in an Anencephalous monster. In this case, a fœtus which was born at the term of utero-gestation, possessed neither brain nor spinal marrow, yet it survived twenty-one hours, and even took nourishment. If, therefore, the evolution of the organs depends upon the nervous system, such evolution must have ceased in this case, so soon as the brain and spinal marrow were destroyed by hydrocephalus or atrophy; yet we find that even if we admit the nervous centres were destroyed in the manner suggested, the organs continued not only to grow, but also maintained their vitality, even for some time after they were thrown upon their own resources. These facts also disprove the opinion advanced by BRERA; that the nervous system is the part first formed in the fœtus, and the essential agent in the evolution of the different organs. This is neither true as regards the cerebro-spinal nerves, nor the ganglionic; for although it is almost certain, for the reasons already assigned, that the ganglionic nerves are never entirely absent in Acephalous monsters, an investigation of the changes which take place during the development of the animal organization has demonstrated, that the formation of the blood-vessels takes precedence of that of the ganglionic nerves, which afterwards become engrafted upon them.

We must then investigate the organization and operations of the system of vegetative or nutritive life, to find an explanation of all the aberrations of the organs which are observed in Acephalous monsters. These, as has been already stated, consist at first of the umbilical vein, which, by a gradual extension throughout the amorphous rudiments of the embryo, forms not only the whole vascular system, but likewise its great vascular centre, the heart itself. This vessel, or its equivalent, exists in all cases, and the parts which are gradually appended to it constitute the essential and fundamental arrangement of the system of nutritive life. But to enable the vessels to perform those acts which are concerned in the process of nutrition, it is indispensably necessary that they should possess some source of innervation. We accordingly find, that the ganglionic nerves everywhere accompany their ramifications — supply the heart, arteries, and veins; twine upon the tunics of these vessels, and "constitute their faithful and constant companions." They not only supply the vascular system, but all the organs concerned in the acts preparatory to nutrition, as those of digestion, sanguification, &c., and likewise those of secretion and excretion, and of reproduction. Those arteries which are merely conductors of blood, without having anything to do with nutrition, as has been justly remarked by TIEDEMANN and BRESCHET, probably constitute the only portions of the vascular system upon which the filaments of the ganglionic nerves do not ramify. These are the umbilical arteries, upon which, according to the observation of BRESCHET, neither his own researches, nor those of DURT, or RIECK, could demonstrate the existence of these nerves. CHAUSSIER and RIBES assert, however, that they were able to follow the ganglionic nerves along the umbilical cord, from the fœtus to the placenta.

Inasmuch, therefore, as the ganglionic nerves probably exist in all cases of monstrosity, (ISENFLAMM and PROCHASKA are the only individuals who have affirmed positively that they were absent,) it is fair to infer, with TIEDEMANN, BRESCHET, and others, that these nerves are the parts most immediately concerned in the production of monstrosity. They are the parts of the nervous system which are first formed, being developed as it were simultaneously with the vessels and the whole system of vegetative life, of which, as has been already remarked, they form a constituent part, and which, as was long since observed by REIL, they serve to animate. If, therefore, the vessels and their companions, the ganglionic nerves, exist in all cases, a presumption which is borne out by the phenomena exhibited by the several cases which have been reported, and these be the immediate instruments of nutrition, it may be legitimately inferred, that all the defects of the organs are owing to a suspension of the process of organic composition, resulting from some interruption of the vital acts of the vessels and ganglionic nerves. The facts already stated clearly demonstrate that these phenomena cannot arise from any disturbance of the heart or the cerebro-spinal centre, because both these parts have frequently been found entirely wanting, while a number of the organs were perfectly evolved.

§ 10. *Muscular System.* In a majority of instances of Acephalous monsters, the muscles which correspond to those bones which are developed, are more or less manifest. In some cases, however, no evidences of the muscular system can be observed. This was the case in the example reported by Odhelius, and in one of those examined by Tiedemann. Winslow observed merely a few fleshy fibres in the neighbourhood of the upper part of the thigh; and in one of Meckel's cases, all the muscles of the right lower extremity were wanting; the left only had the flexors: and in another individual, examined by the same author, the imperfect rudiment of the upper extremity was entirely destitute of muscles. Superville states, that the place of the muscular tissue was supplied by a hard scirrhus-like structure; and Gourraigne, Schelhammer, and Clarke, found merely a homogeneous adipose substance, infiltrated with fluid. Buettner found the muscles of the thorax, shoulder, and lower extremities properly formed, but all the others supplanted by an indurated tissue. In Curting's case, the latissimus dorsi muscle existed, but was not attached to the arm; and Poujol, and Prochaska, found the muscles corresponding to the bones which were developed, properly formed. The cellular tissue existed in all cases. Being the immediate result of the primitive combinations of the organic molecules, it of course can never be absent, where any portion of an embryo is developed.

The absence and defect of the muscular system in Acephalous monsters, are owing to the same causes as the imperfect evolution of the other organs. The primitive condition of the entire organism of the fœtus is a homogeneous, gelatinous mass, composed of simple plastic elements: vessels are finally formed in this substance, and ramify through it; ganglionic nerves are appended, and by subsequent changes all the tissues and organs are developed. A suspension, therefore, of the acts of the formative powers, by which these changes are effected, taking place before they are fully consummated, will leave them in their primitive condition, or at least in the state in which they were when the arrest of development occurred; and if the muscular tissue should not yet have been evolved in the part thus effected, there will of course be no indications of its existence.

The life of the fœtus being purely of a nutritive character, and the plastic elements by which its organs are formed and supported being derived from the maternal blood where they are ready prepared for the uses of its economy, its existence may be sustained while it enjoys the advantages of these connexions, by a very simple arrangement of parts. It will indeed be seen by a review of the facts which have been detailed, that the vessels and the ganglionic nerves, together with their connecting medium, the common cellular tissue, are the only organs or instruments which can be considered as absolutely necessary for its preservation. It has been shown, that amidst the multifarious defects of the organs which have been observed in Acephalous monsters, these parts have never been found entirely wanting, while in some cases they have constituted almost the only organic structures, the presence of which could be satisfactorily recognized in the midst of the rude and formless mass exhibited by the monstrous production. In some instances, indeed, only a small portion of them has existed, there being merely a single vessel to convey the nutritive elements from the mother to the fœtus, which was animated by its corresponding nerves. Without vessels and nerves and cellular tissue, therefore, the fœtus could not advance in the process of organization; yet with these parts, the process of evolution may advance to a considerable extent, without either heart, brain, or spinal marrow, cerebro-spinal nerves, alimentary canal, lungs, genital and urinary organs, muscles, or even bones. We, nevertheless, find that in most cases of *monsters of defect*, some one or more of these organs are superadded, and it will generally be found that they make their appearance precisely in a ratio with their degree of importance in the fœtal economy. Thus, next to the vessels, cellular tissue, and ganglionic nerves, in point of utility, are the alimentary canal and skin, which are almost always more or less developed in Acephalous monsters. To these succeed the spinal marrow and its nerves, the muscular and fibrous tissues, the heart, the organs of sense, the liver, spleen, pancreas, urinary and genital apparatus, and the lungs. The cases which have been reported furnish numerous examples of a partial or total absence of many of these organs, and consequently evidence which is conclusive, that they are not essentially concerned in the evolution of the fœtus.

§ 11. *The vital phenomena of Acephalous monsters.* The vitality of the fœtus during the first month of its existence, is exclusively an appanage of that of the mother. It possesses within itself no separate powers of existence, no faculty of

self-evolution, but its organs are nourished and built up by the supply of plastic materials which it incessantly derives from the maternal blood. This fluid, prepared for its use by the vessels of the placenta, permeates its numerous vessels, percolates, as it were, the interstices of the organic molecules; deposits amongst them the new particles by which its growth is supported, and bears away upon its numerous streams those materials which are no longer useful, and conveys them back to the placenta, from whence they are restored to the circulation of the mother, to undergo new changes, or to be eliminated from the system. Its life is, for the most part, purely vegetative or nutritive. Its apparatus of animal life is only evolved at a late period, and even when formed, it remains inactive, until the period arrives at which the new being is to be thrown upon its own resources, to commence a new career of existence. The facts which have been detailed demonstrate, that it may pass through the entire period of intra-uterine life, without the development of any other than those organs which are strictly subservient to nutrition, and that although its evolution is arrested, it may still live a mere formless fragment, without head, without nervous centre, even without the heart and alimentary canal,—parts which were for a long time regarded as an indispensable condition of fœtal life.

So soon, however, as its dependence upon the mother is destroyed, and it becomes necessary that the organs of animal life should be brought into action; the Acephalous monster, deprived as it is of the most important of these latter organs, must necessarily fall a victim to the exigencies of its new situation. We accordingly find, that although in a few instances monsters of this character have furnished at birth some feeble indications of life, these have been of momentary duration merely, and in a large majority of cases no evidences of vitality have been observed. Out of all the cases of Acephalous monsters which have been reported, Vogli alone observed a slight degree of motion, which continued for a short time after birth. The *Acephalous* fœtus, the account of which was communicated by Mery, is said to have lived twenty-one hours, and to have taken nourishment, although both the brain and spinal marrow were absent. But as Mery did not himself witness these circumstances, the report cannot be considered as entirely authentic.

After all these considerations, it may be useful to inquire how these deformed and imperfectly organized individuals are nourished.

There can be no question that the fœtus derives its principal nourishment from the blood of the mother through the placenta. Yet it has been supposed by many physiologists, that it is also in part sustained by the *liquor amnii*, which they conceive is conveyed into the alimentary canal by deglutition, or through some other channel.

The opinion which refers the nutrition of the fœtus to the introduction of the *liquor amnii* is of ancient date, and was even espoused by some of the Greeks. In modern times this hypothesis has also been advocated by Harvey, Lacourvee, Haller, Treu, and Darwin, who maintain that this fluid is only absorbed by the intestinal canal, (Meckel, *Manuel d'Anat.* III.) Vas, however, Brugmans, Van der Bosch, and Osiander, admit that it may also be absorbed by the skin; and Scheele asserts that it may be absorbed by the lungs, after having entered by the nose and mouth. It has, moreover, been supposed by Lobstein, that this fluid also enters by the genital organs; and according to Oken, it is likewise absorbed by the mammæ, whence it is conveyed by the lymphatic vessels to the thymus gland, and from there to the thoracic duct.

It will be seen, however, from the cases which have been reported, that none of these hypotheses can be admitted, inasmuch as there are numerous examples of Acephalous fœtuses in which all these channels of entrance are absent, except perhaps a small portion of the skin, yet the individual has received a sufficient quantity of nourishment to effect the perfect evolution of some of its organs. In all cases of this kind, the mouth and nose are both absent; and in a large proportion of them, there is also a deficiency of the mammæ and the genital organs, so that there is no channel left by which the liquor amnii could be absorbed, except the skin, and there is no evidence that it performs that office. We may, therefore, settle down to the opinion of Hippocrates, Galen, and others, that the whole of the nourishment which the fœtus receives is from the placenta.

In the course of the observations which we have had occasion to make upon the subject of Acephalous monsters, we have availed ourselves freely of the labours of J. F. Meckel, Tiedemann, Elbin, and Breschet, who have given a very satisfactory digest of most of the cases which exist on record. Breschet, however, in

following nearly the same course which we have ourselves adopted, has done little more than to add a running commentary to the numerous details furnished by Meckel and Tiedemann, which has nevertheless been of considerable use to us. The following may be regarded as the principal sources of the numerous facts which have been collected upon the subject of Acephalous monsters.

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E. Geddings.

ACER. Maple. *Erable*, Fr.; *Der Ahorn*, Germ.

Sex. Syst. Polygamia, Monœcia. *Nat. Ord.* Acerineæ.

Gen. Ch. Hermaphrodite. *Calyx* 5-fid. *Corol.* 5 petals. *Stamens* 8. *Styles* 2. *Samara* winged at end, one-seeded. Male. *Corol.* 5 petals. *Stamens* 8. Lindley.

The genus Acer is composed of twenty-seven species, of which twelve are natives of the United States: they are principally trees of a large size, and most of them yield a saccharine juice. This is particularly abundant in two of our indigenous species.

1. *A. saccharinum.* Sugar maple. *Erable à sucre*, Fr.

Sp. Ch. *Leaves* subcordate, acutely 5-lobed, downy beneath, lobes nearly entire. *Corymbs* appearing before the leaves, loose, nodding. Lindley.

2. *A. nigrum.* Black sugar maple.

Sp. Ch. *Leaves* cordate, 5-lobed, downy beneath. *Corymbs* sessile, nodding. *Fruit* smooth. Lindley.

The first of these species is most common to the north, whilst the other is not found north of latitude 44°, and does not extend to the lower part of the more southern states, but is exceedingly abundant to the west.

For the purpose of making sugar from the juice of these trees, they are tapped in February, March, and April, or whilst the sap is rising. The incision is made with an axe, or, by those who are careful, with an augur. A spout of sumach or elder is introduced into the wound, for the purpose of conducting the juice into a small wooden trough, which is daily emptied into a larger receiver; whence, after having been cleared of chips and other adventitious impurities, it is conveyed to a large boiler, where it is evaporated to a syrupy consistence, and then permitted to granulate: in this state it is of a dark colour, and possesses a peculiar taste, of which even the process of refining does not entirely deprive it. Many persons merely boil it down to a syrup, and preserve it for use in that state. A tree of ordinary size, under favourable circumstances, will yield from ten to twenty gallons of sap, from three to four gallons of which will afford a pound of sugar.

The juice, if permitted to stand before boiling, rapidly runs into the acetous fermentation, and forms a sharp vinegar. In its recent state, if drunk in quantities, it acts on the bowels like the must of grapes or apples. Besides the above-mentioned products, we are also indebted to these trees for four-fifths of the potashes of commerce.

Rafinesque states that the bark of the *A. rubra*, or Red maple, dies wool and flax of a brown colour; and that the Cherokees use a decoction of the inner bark for sore eyes. The European species, *A. pseudo platanus*, or Sycamore, and *A. platanoides*, or Plane tree, also furnish a sweet juice, but not in sufficient quantities to make sugar: the leaves of the latter likewise exude a kind of manna, or concrete sugar.

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R. E. Griffith.

ACERVULUS CEREBRI, (*Glandulæ Pinealis*,) is a term which has been employed to designate the numerous small, granular, earthy particles, which generally occupy the pineal gland. They consist of numerous small grains of variable magnitude, which, when the gland is crushed between the fingers, feel like small particles of sand. They are generally transparent, of a yellowish colour, and of a compact consistence. It is stated by Sœmmering, that in young persons they are of a lighter hue than in the aged, and that in the fœtus they are often so transparent as to be with difficulty detected by the eye. Their volume varies considerably under different circumstances, though it is affirmed by Meckel that they seldom transcend half a line in diameter. They may either occupy the circumference of the pineal gland, or be embedded in its substance; but in either case, they seem to be surrounded by a delicate membrane, which likewise passes in their interstices.

Sœmmering states, that these small earthy granules are found in the pineal gland of the fœtus, but this assertion has not been verified by other observers. The Wenzels represent them as being almost constantly found after the seventh year; and Meckel found them, in some cases, after the sixth. They

were only absent in six cases, out of a hundred, which were examined by the former of these gentlemen, and MECKEL states that they existed in all the cases he examined. Before the seventh year, their place is occupied by a soft viscous substance; and this material is also found intermixed with them in advanced age. Their number bears no relation to the size of the gland, but there are fewer of them in early youth and advanced life, than during the intermediate period.

These acervuli seem to be peculiar to the human subject. It is stated, however, by SŒMMERING and MALACARNE, that they had also observed them in the pineal gland of the goat. RUDOLPHI, nevertheless, affirms, that he had never been able to discover them in any animal.

They are, according to the analysis of PFAFF, composed, for the most part, of animal matter, and phosphate, with a small quantity of the carbonate of lime. HERMBSTADT states, that they are similar in their composition to vesical calculi.

There has been some diversity of opinion as to the precise nature of these concretions. By some, they have been considered of a pathological character; while others, as SŒMMERING, the WENZELS, and MECKEL, regard them as a natural constituent of the healthy organization. MORGAGNI, GUM, and GRÆDING, supposed that they are the result of disease, and that they are frequently either the cause or the effect of insanity. The WENZELS, however, state that they existed in very small quantity in four individuals who were insane. RUDOLPHI seems to consider them as arising from a pathological state of the vessels, and analagous in their characters to similar earthy concretions which are developed in other tissues of the body. He ascribes their greater frequency in the human subject, to the great number of vessels which ramify upon the pineal gland, which he affirms are the instruments by which the earthy matter is poured out.

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E. GEDDINGS.

ACESCENT. *Acescens, Lat.* (From *acescere*, to grow sour.) Substances in which the acid fermentation has commenced, as whey, butter-milk, cider, and beer too long kept, &c. As drinks or aliment, they are often injurious, producing colic, flatulence, cardialgia, &c., especially in persons of weak digestion, or when taken in large quantities. As remedies, they are employed as refrigerants and antiscorbutics, on account of the acid they contain. Whey and butter-milk are most used for this purpose. The humoral pathologists supposed that the fluids in the living body became acescent in certain cases. I. H.

ACETABULUM. (From *acetum*, vinegar, so called from its resemblance to the ancient vinegar vessel.) This term is applied to the deep articular cavity formed by the ilium, ischium, and pubis, into which the head of the femur is articulated.

I. H.

ACETATES. Acetates are salts resulting from the union of acetic acid with a salifiable base. As a class of salts, they are characterized by the following general properties. They are all soluble to a considerable extent in water, except the acetates of mercury and silver, which are but sparingly soluble. Many of their solutions, especially those of the alkaline and earthy acetates, undergo decomposition if kept for several months, and become covered with a greenish mould, being, in the mean time, converted into carbonates. Submitted to destructive distillation, they yield water, carbonic acid, carbonic oxide, oil, carburetted hydrogen, charcoal, acetic acid, and pyro-acetic spirit. (See *Pyro-acetic spirit.*) The relative qualities of acetic acid and spirit generated, depend upon the nature of the acetate. If it be easily decomposed by heat, the acid will be abundant and the spirit deficient; and the contrary will happen, if a high temperature be required to produce the decomposition. This arises from the fact that the pyro-acetic spirit is a product of the decomposition of the acetic acid. The acetate of copper is an instance of an easily decomposed acetate, which for that reason yields a large quantity of acetic acid, while the acetates of potassa, soda, lime, zinc, &c., resisting decomposition, furnish much pyro-acetic spirit. All the acetates are decomposed by the stronger acids, such as the sulphuric, muriatic, nitric, &c., which form a new salt with the base, and liberate the acetic acid, which partially rises in fumes, having the smell of vinegar. They are all artificial salts, except the acetate of potassa, which exists

in the sap of vegetables, and the acetate of ammonia, which is present in putrid urine.

Preparation, &c. The acetates are generally procured by direct combination; that is, by treating salifiable bases or their carbonates with acetic acid. A few, however, are obtained by the way of double decompositions. The following is a list of the acetates at present used in medicine and pharmacy. 1. Acetate of potassa, or foliated earth of tartar; 2. Acetate of soda; 3. Acetate of ammonia, or spirit of Mindererus; 4. Acetate of lime; 5. Acetate of iron, of which the Dublin College have a tincture, and alcoholic tincture; 6. Acetate of lead, or sugar of lead, and sub-acetate of lead, or Goulard's extract, the latter forming lead-water when sufficiently diluted; 7. Acetate of zinc, of which there are an officinal solution and tincture; 8. The acetates of copper, including the impure acetate, or verdigris, the prepared impure acetate, and the crystallized acetate or crystals of Venus; 9. Acetate of mercury; 10. Acetate of morphia; 11. Acetate of quinia. All these acetates, except those of lime, morphia, and quinia, are officinal in the United States and British Pharmacopœias; they will be described under the heads of their respective bases, to which the reader is referred. The acetates, as a class, have no common medical or toxicological properties; and, therefore, cannot be characterized, in these particulars, under the present head. They consist generally of one equiv. of acid 51, to one equiv. of their respective bases. When the base happens to be an oxide, the ratio of the quantity of acid to the quantity of oxygen in the base is as 51 to 8. Hence it is that a deutoxide generally unites with two equiv. of acid. Franklin Bache.

ACETIC ACID. (From *acetum*, vinegar.) This is the peculiar acid which gives rise to the sourness of vinegar, in which it exists largely diluted with water, and associated with several vegetable substances. (See *Vinegar*.) It is found in nature, and is often a product of art. It is present in the sap of most plants, either free or united to potassa, and has been detected in the sweat and urine of man, and in milk. It is occasionally developed in the stomach, in consequence of imperfect digestion. Besides being a product of the acetous fermentation, it is also generated, during the destructive distillation and spontaneous decomposition of animal and vegetable substances, and by the action of the mineral acids on them.

Preparation. Acetic acid may be obtained from vinegar, by first distilling it, and then saturating the distilled product with some base. An acetate is thus formed, which must be decomposed by means of sulphuric acid. This will combine with the base, and disengage the acetic acid. But as vinegar contains but very little acetic acid, this process is not an eligible one. The general formula for obtaining acetic acid is to decompose certain acetates ready formed, either by means of sulphuric acid, or by a distillation per se. How the acetates employed are first obtained, will be found described under the heads of their several bases. The acetates usually employed are those of *soda*, *potassa*, *lead*, and *copper*. The three first are decomposed by sulphuric acid; the last, by a distillation per se. The United States Pharmacopœia uses the acetate of soda, and directs it to be distilled with half its weight of sulphuric acid. The Dublin College prescribes a similar process, substituting the acetate of potassa for that of soda; and the Paris Codex adopts the destructive distillation of the crystallized acetate of copper (crystals of Venus). The Edinburgh College has a peculiar process, consisting in the distillation of a mixture of dried sulphate of iron, and acetate of lead. A double decomposition first takes place, resulting in the formation of acetate of iron and sulphate of lead. The heat of the distillation afterwards decomposes the acetate of iron, and drives over the acetic acid; and there is left in the retort, the sulphate of lead, mixed with the oxide of iron.

According to Berzelius, the cheapest method of preparing acetic acid, is from the acetate of lead. He directs a tubulated retort to be connected with a dry receiver by means of moistened bladder, and, when the junctures are nearly dry, to add to it a portion of perfectly effloresced acetate of lead, (sugar of lead,) on which is to be poured three-tenths of its weight of concentrated sulphuric acid; the mixture being well stirred with a glass rod. The retort is then placed in a sand-bath, and the distillation conducted with a moderate heat. To accelerate the distillation, it is advantageous to cover the body of the retort with a cone of thin pasteboard, made so large as not to touch the glass. The sulphuric acid, in uniting with the oxide of lead, has its combined water transferred to the acetic acid, which in this state distils over. The acid, however carefully distilled, always has a sulphureous odour, derived from a little sulphurous acid, to remove which a small quantity of peroxide (brown oxide) of lead must be added, which acts by first converting the sulphurous into

sulphuric acid, and then neutralizing the latter. When the odour is entirely removed, the acid is carefully decanted from the remaining oxide, and the sulphate formed.

The decomposition of the acetate of copper (crystals of Venus) is conducted in a stone-ware retort. This is two-thirds filled with the salt, and placed in a reverberatory furnace. It is then connected, by means of an adopter, with a tubulated receiver, the tubulure of which is furnished with a long straight tube, to carry off the gaseous products. Upon heating the furnace, part of the acetic acid is decomposed, but the remainder distils over, in the form of thick vapours, into the receiver, which must be kept cool with wet cloths. The product is always contaminated with a little acetate of copper, and has a greenish colour; and hence it requires to be submitted to a second distillation.

Properties, &c. Acetic acid, in the most concentrated form in which it can exist, still contains a portion of combined water. In this respect it follows the analogy of the nitric, sulphuric, and other mineral acids. But the pharmaceutical acid, though not of this strength, is still called *acetic acid*. When as concentrated as possible, in which state it is called *radical vinegar*, it is a colourless liquid at the temperature of 60°, having a strongly acid and corrosive taste, and an acid, pungent, and refreshing smell. Its sp. gr. is 1.063. At the temperature of 55°, it becomes a crystalline solid. It consists, in this state, of one equivalent of dry acid 51, and one equiv. of water 9 = 60. This water is not water of dilution, but essential water, without which the elements of the acid would not hold together. When diluted with water, its density increases until it reaches 1.079, after which further dilution causes it to become lighter. Hence it is that the strength of the acid cannot be judged of with certainty from the specific gravity, but should be determined by its saturating power with reference to a carbonated alkali. This is one of the few vegetable acids that volatilize without decomposition. Its boiling point is somewhat above 212°. When boiled in open vessels, it takes fire, and burns with a blue flame like that of alcohol. The acid used in medicine, contains variously from 34 to 50 per cent. of water of dilution. In this state, it is still a very sour and acrid liquid, possessing a fragrant, pungent smell. It unites with water in all proportions, and dissolves to a certain extent in alcohol. It has the property of dissolving the volatile oils, camphor, gluten, resins, gum-resins, fibrin, albumen, &c. When pure, it should not be precipitated by a soluble salt of baryta; but if a precipitate be formed, it indicates the presence of sulphuric acid. When heated in a glass capsule, it should evaporate without residue. Copper, lead, and tin, the most usual metallic impurities, may be detected, the first by a brown cloud being produced by ferrocyanate of potassa, the second, by a white precipitate occasioned by sulphate of soda, and the third, by a dark-coloured precipitate caused by sulphuretted hydrogen.

Dry acetic acid consists of three equivalents of hydrogen 3, four of carbon, 24, and three of oxygen 24. (Dr. Prout.) This makes its equivalent, or combining weight, 51.

Therapeutical Applications. Acetic acid is stimulant and rubefacient. Owing to its volatility and pungency, the vapour arising from it is frequently applied to the nostrils in fainting and headach. When intended to be used as a nasal stimulant, it is generally added to a small quantity of powdered sulphate of potassa, so as to moisten the salt, contained in a small ground-stoppered glass bottle. It acts as a powerful rubefacient, producing redness and burning heat, with destruction of the cuticle. If applied by means of blotting-paper or fine cambric, it speedily produces vesication, and is sometimes used as a substitute for a fly-blister, in cases of sudden inflammation, such as croup, &c., which do not admit of delay. In pharmacy, it is used to form the *camphorated acetic acid*, which is simply a solution of camphor in the acid, and is intended as an officinal substitute for Henry's *aromatic spirit of vinegar*. In this form, it is a very pungent and grateful excitant, when snuffed up the nostrils, in fainting, headach, and nervous debility. Diluted to a certain extent with water, it forms the dilute acetic acid of the U. S. Pharmacopœia, which is a convenient preparation, of about the same strength as vinegar, for forming the acetates extemporaneously, such as the acetate of potassa, spirit of Mindererus, &c.; distilled vinegar being objectionable for this purpose, on account of the mucilage, and other substances which it contains. The *aromatic acetic acid* of the Ed. Pharm. is a solution of certain volatile oils in vinegar. (See *Vinegar*.) The preparations called *Acetica* are solutions of various medicines in vinegar, and will be noticed under the latter word. Acetic acid, in its most concentrated form, would no doubt prove poisonous, if taken

into the stomach in sufficient quantity; but when sufficiently diluted, it is perfectly innocent, as might be inferred from the fact of the habitual use of vinegar with food.

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FRANKLIN, BACHE.

ACETOSA. See *Oxalis.*

ACETOSELLA. See *Rumex.*

ACETOUS ACID. This name was formerly applied to the acid of vinegar, under the erroneous belief that it was less oxygenated than the acid obtained by decomposing the acetates. The identity of the two acids having been long since established, the single term, *acetic acid*, has been applied to both, and the name *acetous acid* has become obsolete.

F. BACHE.

ACHILLEA. MILFOIL, YARROW. *Millefeuille*, Fr. *Garbenkraut*, Germ. *Millefoglie*, Ital.

Sex. Syst. Syngenesia polygamia superflua. *Nat. Ord.* Compositæ *sub ord.* Anthemideæ.

Gen. Ch. Involucrum ovate, imbricate, unequal. *Receptacle* plane, chaffy. *Florets* of the ray 5-10 roundish, obcordate. *Pericarps* naked. LINDLEY.

Many species of this extensive genus have been at different times employed in medicine as tonics and vermifuges.

1. *A. ageratum.* Sweet Maudlin. *Eupatoire de Mesué*, Fr.; *Leberbalsam*, Germ.

Sp. Ch. Leaves oblong, blunt, serrated, narrowed into the petiole, fascicled, glabrous. *Corymb* compound, contracted. LINDLEY. This plant is a native of the southern parts of Europe, and has been employed as a vermifuge for infants; though it is now but seldom prescribed.

2. *A. millefolium.* Milfoil. *Herbe à la coupure*, Fr. *Schaffgarbe*, Germ.

Sp. Ch. Leaves bipinnate, slightly hairy, their segments linear, toothed, acute. *Stems* furrowed. LINDLEY. The milfoil is common both to Europe and the United States, growing in woods and fields, and flowering almost the whole summer. The American plant is possessed of more decided powers than the European. The flowers yield an essential oil, with an aromatic odour, and a bitter taste, somewhat similar to that of chamomile. The great reputation of this plant has arisen from the supposed efficacy of its leaves in the cure of recent wounds; they are also given in decoction as a tonic. HOFFMAN considers the flowers as antispasmodic; and LINNÆUS states, (*Flor. Lappon,*) that the Dalecarlians are in the habit of adding them to beer, with a view of increasing its intoxicating effects. The root has been proposed as a succedaneum for Serpentaria, but trials made with it have proved its inefficiency.

3. *A. Moschata.*

Sp. Ch. Leaves pectinate, pinnate, smooth. *Pinnæ* linear, bluntish, entire, dotted. LINDLEY.

This species, and the *A. atrata* and *A. nava*, which are remarkable for their strong musky odour, constitute the *Genipi* of the Savoyards, and are much esteemed by them for their vulnerary and sudorific properties. The *A. moschata* also furnishes a distilled water, which is much used in Europe, under the name of *Esprit d'Iva.*

4. *A. Ptarmica.* Sneezewort. *Herbe à eterneur*, Fr. *Niesekraut*, Germ.

Sp. Ch. Leaves linear, lanceolate, acuminate, sharply serrate. LINDLEY.

The Sneezewort is common in Europe; and, according to PURSH, is also found in the United States. It is slightly odorous, and its leaves have a taste somewhat resembling those of the Tarragon. The root and leaves, dried and reduced to powder, are frequently employed as a sternutatory. The root is also used to produce an increased secretion of saliva, and as a remedy against toothache. A decoction of the plant has some reputation in Russia, in Hematuria and Menorrhagia.

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R. E. GRIFFITH.

ACHILLIS TENDO. The common tendon of the gastrocnemii muscles and which is inserted into the os calcis. This tendon is sometimes ruptured or cut. See *Tendons, ruptures of.* I. H.

ACHOR, a name given to a small species of pimple which makes its appearance on the hairy scalp and face. Authors do not agree with regard to the derivation of the term. BLANCHARD, for example, makes it come from α priv. and χωρος, place, signifying their small extent. Others again derive the term from αχνη, bran, branny scales being thrown off. GALEN, and other ancient writers who followed him, seem to have understood by the plural *achores*,

"ulcerations peculiar to the hairy scalp, discharging, from very small pores, a viscid ichor, consequent to pustules." But subsequently, a distinction was drawn between the primary pustules and the ulcerations in which they terminated, these last being called *favi*, whilst the term achores was restricted to the first stage previous to ulceration. Alexander Trallianus, and Actuarius, were the first to make this distinction. Willan, the standard authority in our language upon the subject of cutaneous diseases, defines achor, "a small acuminated pustule, containing a straw-coloured matter, having the appearance and nearly the consistence of strained honey, appearing most frequently about the head, and succeeded by a thin brown or yellowish scale."

The plural *achores* has been employed by most of the late medical authorities to designate the primitive eruption in that form of pustular inflammation which is common to infancy, denominated in English, *porrigo larvalis*, or *crusta lactea*,—from the abundant exudation upon the face forming a kind of mask or crust,—and by the French, *teigne muqueuse*, from the glutinous, mucous character of the discharge.

The term achor is therefore now entirely confined, by the best authorities, to the primary stage of a species of cutaneous eruption appearing upon the scalp and face in early infancy, chiefly during the period of lactation. As, therefore, it constitutes but an elementary form of a distinct pustular inflammation, we shall delay its further consideration until we treat of the particular disease, namely, *porrigo larvalis*, under which the nature and characteristics of achor will be more appropriately considered. G. Emerson.

ACHROMATIC. (From α priv. and χρωμα, colour.) Literally means without colour. Light is composed of rays of different colours, and white is formed by the assemblage of all these rays. The rays of light being unequally refrangible, in passing through certain media they become dispersed, and the images of objects thus seen exhibit various colours, and are more or less indistinct. The term achromatic is given to instruments which are so constructed as to remedy this aberration in the refrangibility of the different rays of light. The eye is an achromatic instrument. I. H.

ACIDS. (From *acidus*, sour.) Acids, in chemical classification, are certain compounds which have the power of uniting with alkalies, earths, and oxides proper, in definite proportions, with the effect of forming combinations, in which the properties of their constituents are mutually destroyed. Such combinations are said to be neutral, and are denominated salts.

§ 1. *Chemical Considerations relative to Acids.* Acids are generally characterized by having a sour taste, and by the power of reddening vegetable blue colours; but they do not universally possess these properties; and hence the essential character of this class of bodies is to be sought in other circumstances. That character will be found to consist in this,—that they are compounds which are strongly electro-negative; and, possessing this electrical relation, no matter what may be their taste or action on colours, they are fit to produce neutral combinations, or salts, with electro-positive compounds, that is, with alkalies, earths, and oxides. The properties, however, which belong so generally to acids, of possessing a sour taste, and of reddening vegetable colours, are exceedingly convenient tests of their presence in ordinary cases; and hence the chemist is constantly in the habit of availing himself of them. In employing these indications, it is only necessary for him to recollect that some acids, such as the tungstic and antimonic, are without taste, in consequence of their insolubility, and that a few others, as for example silica, (called silicic acid by Berzelius), have no effect on vegetable colours.

Lavoisier, from observing how generally oxygen was present in acids, was led to form the theory that this element was the principle of acidity. This theory has been long since proved erroneous; as a number of acids have been discovered which contain no oxygen.

The acids are generally arranged, according to their source, in the three great classes of *mineral*, *vegetable*, and *animal acids*.

The *mineral acids*, or those derived from *inorganic matter*, are most conveniently divided into those in which the radical or basis is united with oxygen; and those in which it is combined with hydrogen. The former are called *oxacids;* the latter, *hydracids*. The principal oxacids are the sulphuric, nitric, phosphoric, chloric, bromic, iodic, carbonic, and boracic; the principal hydracids are the muriatic, hydrobromic, hydriodic, hydrofluoric, and hydrosulphuric (sulphuretted hydrogen.) Those oxacids, having a metallic radical, are often classed together under the name of *metallic acids*. The principal ones are the arsenious, arsenic, antimonious, antimonic, chromic, molybdic, and tungstic acids.

The *vegetable acids* comprise those derived directly or indirectly from the vegetable kingdom; and are, with few exceptions, composed of hydrogen, carbon, and oxygen. Their number, in modern times, has been very much multiplied, in consequence of the rapid progress which has been made in vegetable analysis; so that a mere catalogue would take up considerable space. The principal ones are the acetic, amylic, benzoic, boletic, camphoric, ceric, citric, ellagic, gallic, igasuric, kinic, krameric, malic, margaric, meconic, mucic, (saclactic,) oleic, oxalic, pectic, prussic, (hydrocyanic,) rheumic, suberic, succinic, sulphovinic, and tartaric. All the acids belonging to this class are colourless, solid, and specifically heavier than water. They are all devoid of smell, except the acetic acid. The benzoic acid is not an exception; as the odour which it ordinarily has, arises from impurity. When submitted to heat in a retort, three only, the acetic, meconic, and pyromucic, volatilize without decomposition. The rest are either partially or totally decomposed; the products in the latter case being water, carbonic and acetic acid, and charcoal. All the vegetable acids, except the ellagic, margaric, and oleic, are soluble in water. A few, indeed, are but sparingly soluble, such as the camphoric, mucic, and suberic, which circumstance accounts for their slight action on vegetable blues. Most of the vegetable acids are soluble in alcohol, and more so in hot than in cold alcohol. With few exceptions, they are decomposed by concentrated and boiling nitric acid, the products being usually water and carbonic acid.

The principal *animal acids* are the uric, (lithic,) purpuric, rosacic, amniotic, lactic, formic, caseic, margaric, oleic, stearic, butyric, sebacic, cholesteric, and prussic or hydrocyanic. The margaric, oleic, and prussic acids are also of vegetable origin, and have been already enumerated as vegetable acids. A few of the vegetable acids proper, are occasionally found in animal substances; as acetic acid, in urine, sweat, and milk; benzoic acid, in the urine of several herbivorous quadrupeds, and in castor; oxalic acid, in the peculiar species of urinary concretion, called the mulberry calculus. The first seven acids on the above list, are more or less oxygenated; the remainder, except the last, are called fatty acids, and contain scarcely any oxygen. The last is a hydracid with a compound radical. The composition of the animal acids is not uniform. A few follow the analogy of animal matter generally in containing nitrogen, associated with the hydrogen, carbon, and oxygen; but the majority embrace the three last mentioned principles only.

Most of the strong acids contain water as an essential constituent; and hence, with few exceptions, they cannot be isolated by any known process. The nitric, chloric, and oxalic acid, not to mention others, are constituted in this way. It is true that the water may be separated; but this can only be done by substituting for it some base. For acids containing essential water, Berzelius proposes the term *aqueous* acids, restricting the term *hydrate* to combinations of salifiable bases with water. This plan, however, is not followed by English and American chemists, who call the acids in question hydrated acids.

The capacity of saturation of an acid is often mentioned in books published on the continent of Europe, and means the quantity of oxygen present in the different bases, necessary to saturate a given quantity of it. Thus, suppose that 100 parts of sulphuric acid should require for complete saturation a quantity of base, containing uniformly 19.96 parts of oxygen, then the capacity of saturation of this acid would be said to be 19.96; and so of the rest. The quantity of oxygen in each base, requisite to saturate a given acid, is necessarily the same, as plainly follows from the system of equivalent numbers; for if the saturating base is a protoxide or a deutoxide, the equivalent number or saturating quantity of either oxide, as the case may be, will always contain the same quantity of oxygen. In those peculiar cases, in which a protoxide and deutoxide of the same radical are both salifiable bases, it is generally found that whatever quantity of acid is necessary to saturate the protoxide, twice that quantity is required for the deutoxide; thus preserving a constant ratio between the amount of the acid, and the amount of the oxygen in the base.

The acids, as a class, have no general chemical properties, other than those which have been mentioned. The properties of such of the acids as are connected with physiology, the practice of medicine, or toxicology, will be noticed in their alphabetical places throughout the present work.

§ 2. *Therapeutical Application of Acids.* In reference to their action as remedies, the acids may be divided into the *mineral* and *vegetable.* The *mineral acids,* including under this term the muriatic, nitric, and sulphuric, act differently according to their

state of concentration. When concentrated, they operate as caustics, decomposing the animal fibre, and producing an eschar. As escharotics, however, they are little used; other substances, such as caustic potassa, being more manageable for that purpose. When in a dilute state, they are deemed tonic and antiseptic, and are accordingly given in fevers of a typhoid type, with great advantage. These acids also are used with advantage as antilithics, when the phosphatic diathesis prevails; that is, when the urine is prone to deposit a *white sediment*. For correcting this defect in the composition of the urine, the muriatic and sulphuric acids are more relied on than the nitric, which is apt to disorder the stomach. The *vegetable* acids are always used in a dilute state, and are classed as refrigerants and diuretics. They are, hence, very much employed as cooling drinks in inflammatory fevers, to which the dilute mineral acids are not considered applicable. The principal ones employed are the acetic, citric, and tartaric. Like the mineral acids, they are proper in nephritic complaints, characterized by the prevalence of the phosphatic diathesis; but are, perhaps, less efficacious than these acids, as they are liable to be decomposed in the processes of digestion and assimilation. The most grateful form in which the vegetable acids can be administered, is that in which they exist naturally, combined with saccharine matter, in the acidulous fruits, such as the orange, the lime and lemon, the tamarind, the peach, &c. The predominant acid here is the citric acid; and hence it is, that when the fruits cannot be procured, the best substitute is a lemonade made by dissolving a small portion of the crystallized citric acid in water, and sweetening the solution with white sugar. Tartaric acid, which is much cheaper than the citric, may be used for a similar purpose.

The above forms an outline of the therapeutical applications of the acids as a class; but it should be recollected that each acid possesses remedial properties more or less peculiar, which can be properly detailed, only under the head of each. Certain acids, such as the arsenious, benzoic, hydrocyanic, succinic, &c. cannot be described as remedies under a general head; as they hardly have a property in common. For the effects of these as medicines, the reader is referred to the head of each acid.

§ 3. *Toxicological Properties of Acids.* Many of the acids, when taken into the stomach in a concentrated form, or in an over-dose, act as poisons. Among these may be enumerated, as the most important in a practical point of view, the three mineral acids, and the arsenious, hydrocyanic, hydrosulphuric, (sulphuretted hydrogen), and oxalic acids. The citric and tartaric acids arranged by Orfila as irritant poisons, have been proved, by the experiments of Drs. Christison and Coindet, to be devoid of poisonous properties altogether. The symptoms and morbid appearances produced by the mineral acids as poisons, being in many respects similar, and the antidotes to be employed being the same, their toxicological properties admit of being treated of together. But the effects of the other acids mentioned are so very diverse as not to admit of being noticed under a general head. For these effects the reader is referred to the article appropriated to each acid.

The ordinary symptoms produced by the mineral acids in poisonous doses are whiteness, yellowness, or blackness of the lips and lining membrane of the mouth; burning heat of the mouth, œsophagus, and stomach; hiccup; nausea; frequent eructations; violent efforts to vomit; repeated and excessive vomiting, generally of a blackish or brownish matter; excruciating pain in the stomach and bowels; exquisite tenderness of the abdomen; burning heat or icy coldness of the surface; great thirst; extreme restlessness; fetidness of breath; smallness and concentration of the pulse; contortions of the features, expressive of great agony; and finally convulsions, which generally end in death.

The morbid appearances are, disorganized, brownish, or yellowish-brown spots on the lips, and other parts of the skin; disorganized, generally hardened, condition of the lining membrane of the mouth; which is whitish or yellowish, when the poison has been the sulphuric acid, yellowish, when the nitric; similar condition, or extreme redness of the pharynx; a dense yellow, firmly adhering membrane lining the œsophagus; vascularity or lividness of the outer surface of the abdominal viscera; effusion of fibrin and adhesions between the convolutions of the intestines; distension of the stomach with gases, when not perforated; yellowish-brown, or black matter in this viscus, and a thick paste, lining its interior surface, composed of disorganized tissues, blood, and mucus; excessive injection and blackness of its vessels; a similar condition of the duodenum, &c. When the stomach is perforated, the hole is circular, and the coats are thin at the margin, coloured, and sur-

rounded by vascularity and black extravasation. When death takes place after a considerable interval of time, extending from a fortnight to several months in different cases, constituting the chronic variety of poisoning by acids, the appearances are different. The body is extremely emaciated. The stomach and intestines are excessively contracted; the former, so as to measure, in some instances, only a few inches in length; the latter, so as not to exceed a writing-quill in thickness. The stomach exhibits spots of regenerated villous coat, smoother and redder than the natural membrane. The viscus is found frequently to adhere to the neighbouring organs; and at the points of adhesion, its coats are sometimes wanting altogether. (Christison.)

It is sometimes important to discriminate between the effects of the mineral acids on the living and dead body, in order to determine whether they were the cause of death, or were introduced into the body after death. Orfila has furnished the data for the solution of this problem. When a mineral acid acts upon the dead tissues, the injury is confined to the parts actually touched, is surrounded by an abrupt line, and shows no sign of inflammatory redness; while the contrary is the case when the living tissues are attacked.

In treating cases of poisoning by the mineral acids, the first thing to be attended to, is to administer magnesia, which, by neutralizing the acid, acts as a true antidote. As delay is productive of the greatest mischief, on account of the extreme rapidity with which these poisons act, it will be proper, in case the antidote is not at hand, to use a solution of soap, until it can be procured; and, while the soap is preparing, the acid should be diluted by the free use of some mild fluid, milk or oily substances being preferred. After the acid has been neutralized, diluents must be continued in large quantities, as they facilitate vomiting. In treating the supervening inflammation, the general principles for combating that condition must direct the practitioner.

Poisoning by the mineral acids is very generally fatal. Recovery could hardly take place after a considerable portion of these acids had reached the stomach; but, in point of fact, when the acid is taken by accident, or even with a suicidal intention, the power of deglutition is often suspended before any considerable portion of the acid has been swallowed. The prognosis is to be deduced from quantity and strength of the acid swallowed, and the greater or less promptness with which the antidotes have been used. Of fifty-five cases of poisoning by nitric acid, recorded by Tartra, about half recovered more or less perfectly. The prognosis is less favourable in poisoning by sulphuric acid.

§ 4. *Chemical Tests of the Acids.* The tests of the acids in detail are best studied under the head of each acid; but, as the discrimination of the acids, where poisoning is suspected to have been produced by some one of them, is frequently a chemical problem presented to the medical jurist, an outline of the mode of procedure may be proper in this place. And here it will not be necessary to show how all the acids are discriminated from each other, but rather to take the subject in a practical point of view, and inquire, how those acids are to be distinguished and detected, which are likely to be agents in cases of poisoning. The acids answering to this description, are the hydrocyanic, hydrosulphuric, (sulphuretted hydrogen,) oxalic, arsenious, arsenic, nitric, sulphuric, and muriatic. The hydrocyanic and hydrosulphuric acids may be detected by their smell; the former having the odour of bitter almonds, the latter, of putrid eggs. If neither of these smells is perceived, the acid should be tested by lime-water. If a white precipitate is formed, it is either the oxalic, arsenious, or arsenic; if no precipitate is generated, it may be inferred to be the nitric, sulphuric, or muriatic. Supposing the first case, the precipitate is next subjected to an excess of the precipitant, in which if it be insoluble, the acid is proved to be the oxalic. In case the precipitate is soluble in an excess of the lime-water, the acid should be tested by the ammoniacal nitrate of silver, which will form a yellow precipitate if it be arsenious acid, and a brick-red one if the arsenic acid. In the case of no precipitate being formed by lime-water, the acid may be subjected to the action of copper. If reddish fumes are given off, the acid is proved to be nitric; if no fumes, it is either the sulphuric or muriatic. To determine which, barytic water is added, which causes a white precipitate with the sulphuric acid, but none with the muriatic. In this way, evidence is obtained, in a general way, of the peculiar nature of the acid present; but before making up his opinion conclusively, the medical jurist should submit the given acid to various additional trials, to determine whether his first impressions are confirmed. For the details of proceeding for such a purpose, the reader is referred to the head of each acid.

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FRANKLIN BACHE.

ACIDITY. The property possessed by certain bodies of producing upon the organs of taste and smell a peculiar sensation, on which the term acidity or sourness has been bestowed. Acidity does not appertain to simple acids solely; it belongs also to many compound substances, which contain an acid either in combination, as in certain salts; or only mixed with other principles, whether the acid exist naturally or be accidentally developed by fermentation.

All the excreted fluids, as the urine, sweat, milk, gastric fluid, &c., possess, even in health, some degree of acidity, resulting from the presence of acetic or hydrochloric acid; and in disease, this property becomes sometimes more intense, especially in children affected with crusta lactea or achores, in recently delivered women, in chlorotic girls, in maniacs, in scrofulous and consumptive persons, &c. In eruptive fevers, inflammations of glands, &c., patients exhale a sourish odour. The ancients attached great value to this character, both in a semeiological and therapeutic point of view, but at the present day it is considered to be of little importance.

The acidity of the humours was formerly one of the principal species of acrimony. (q. v.) This property in the circulating fluids, according to the doctrine of SYLVIUS and BŒRHAAVE, was regarded as the proximate cause of a number of diseases: a doctrine now rejected.

The liquids and gases contained in the stomach, either in consequence of a defect of the assimilative action of the digestive organs, or from the acescent nature of the ingesta, sometimes acquire an acidity which is productive of irritation in that organ. (See *Cardialgia*, *Pyrosis*, *Eructation*, &c.) I. H.

ACIESIS, (From α priv. and κυειν, to conceive.) A name given by VOGEL to sterility in females. I. H.

ACINESIA. (From α priv. and κινειν, to move.) Immobility. Also applied by GALEN to designate the interval of repose between the systole and diastole of the arteries. I. H.

ACINUS. The Latin word for grape, or rather grape-stone. It was introduced into medical language by SYLVIUS DELEBOE, to designate the granulations of the conglomerate glands. The term *acini glandulosi* has been given to glands, which, like the pancreas, are arranged, as it were, in clusters. I. H.

ACIPENSER. Sturgeon. A genus of chondropteriginous fishes, most of the species of which are used for food, and from which *Caviare* and *Ichthyocolla* (q. v.) are prepared. I. H.

ACME. (From ακμη, a point.) The top or height of any thing. It is used in pathology to express the utmost height of a disease. The ancients distinguished diseases into four stages: 1. Αρχη, the commencement; 2. αναβασις, the period of increase; 3. ακμη, the height; 4. Παρακμη, the decline. I. H.

ACNE. Ακνη. (Derived, according to CASSIUS, from ακμη, vigour.) Ιονθος, Gr.; *Varus*, Lat.; *Psydrachia Acne*, SAUV. *Gutta Rosea*, DARWIN; *Ionthus*, GOOD; *Bouton Couperose*, Fr.; *Die Finnen*, Germ. *Carbuncle*, *Stone-pock*, *Welk*, Eng.

A genus of cutaneous diseases, of very frequent occurrence, consisting of an eruption affecting chiefly the cutaneous tissue of the face. Its immediate seat is ordinarily in the sebaceous follicles, and its common characteristics, pustules, usually very small in size at first, proceeding slowly to suppuration,—the matter being confined to their points,—hard at their bases, and often surrounded with more or less inflammation or redness, and sometimes by a purplish or livid hue. It appears most commonly upon the sides of the nose, the forehead, chin, and cheeks, but may also be occasionally seen upon the neck, shoulders, and upper part of the chest.

Classification and varieties. Notwithstanding the general uniformity of character presented by acne, considerable diversity of opinion has existed among pathologists and writers upon cutaneous diseases, with regard to the order to which it properly belongs. Most of the English authorities, such as WILLAN, BATEMAN, PLUMBE, and MACARTNY, have considered it as essentially a tuberculous affection, and arranged it in the class Tubercula; whilst the French authorities, ALIBERT, BIETT, and others, have regarded it as strictly of a pustular character in its commencement, the tubercles forming consecutively as the product of inflammation, which, in a greater or less degree, always precedes and accompanies the pustules. This inflammation, when it has frequently recur-

red without terminating in complete resolution, leaves indurations in the follicles, which constitute the cutaneous tubercles. The small tumours do not, however, regularly follow the inflammation, and are usually developed after the disease has subsisted for some time, and the cellular tissue become involved. Neither do they manifest themselves simultaneously, but succeed each other, in greater or less number, upon the different parts affected. Such a view of the pathology of the disease, furnishes the French authorities with strong grounds for contesting the propriety of the specific distinction made by the English and other writers who found it upon the tubercles alone, as though these constituted a distinct and independent lesion.

By some of the older Italian and French authors, all the varieties of acne were considered as so many stages of the same affection. Thus, NICHOLAS FLORENTINUS, SENNERT, and AMBROSE PARE, have designated three degrees or stages; the first, marked by simple redness of the skin; the second by pustules, and the third by ulcerations. The last, if ever met with, must be very unusual; and it is most probable, that where it is said to have been seen, some other cutaneous affection, now otherwise designated, was mistaken for a variety of acne. ASTRUC, however, viewed each of these supposed stages as a distinct variety, of which he designated three; namely—1. simple acne; 2. varicose acne, characterized by dilatation of the minute superficial veins of the face; 3. squamous acne. This division into distinct varieties or species, rather than stages, has been generally adopted by the later writers. Thus, CHIARUGI has described three, which he designates *rosa vera*, *rosa discreta*, and *rosa herpetica*. BATEMAN makes four species, namely, *acne simplex*, *acne punctata*, *acne rosacea*, and *acne indurata*. These embrace many of the varieties designated by ALIBERT under the designation of *dartre pustuleuse*, such as the *dartre pustuleuse couperose*, *dartre pustuleuse disseminée*, and *dartre pustuleuse miliaire*.

BIETT, who may perhaps be considered at the present time as the highest authority upon the subject, has adopted the division into distinct varieties, together with the designations of BATEMAN, adding, however, one other, which he calls *acne sebacea*, thus making five species of acne. As this last division has the advantage of embracing all the varieties of the disease treated of by the latest and best authorities, it will be adopted in the present article.

Acne, in most of its forms, is an affection incident to both sexes, especially from the period of puberty to the age of thirty-five or forty. There cannot be a doubt that its occurrence is, for the most part, dependent upon the influence exercised by the generative system, the presence of the eruption having the closest correspondence with the first manifestations of puberty, whilst the affection is comparatively rare after the decline of sexual vigour. From extensive observation, it has been found, that *acne simplex*, *acne punctata*, *acne indurata*, and especially *acne sebacea*, show themselves almost invariably either in the first period, or more advanced stages of adolescence, aged persons being hardly ever subject to them; whilst the variety called *acne rosacea* is almost as constantly confined to men of mature age, and females about or after the cessation of the menses. Females have been generally thought the most frequent subjects of acne. The temperaments most liable to be affected with it are the sanguineous in youth, and the bilious in more advanced age. As these conditions of the system are hereditary, the diseases to which they predispose may likewise be considered as so far hereditary; and, in this way, acne can be set down as among those affections capable of being transmitted through parents to their offspring. In those predisposed to acne, and who have attained the ages most subject to it, the development of the disease is favoured by several causes, the most frequent of which are, excesses of the table, in partaking of food too rich or too stimulating, or the other extreme of living, that is to say, upon too spare and meagre fare. To these may be added, the influence of certain moral affections, such as grief, fright, anger, etc.

Diagnosis. There is, in general, little difficulty in distinguishing the varieties of acne from other cutaneous affections appearing in the same situations, if proper attention be given to the very distinctive characteristics of the disease, especially to its chronic nature, isolated and acuminated points or pustules, terminating very slowly in hard, reddish tubercles. Nearly all those diseases which might be confounded with acne from their occurring in the same situations, are either more rapid in their stages, make their appearance more simultaneously, terminate in ulceration, scaly crusts, or flattish tubercles, superficial, and also remain but a short time.

1. *Acne simplex. Vari*, Latin; *Dartre pustuleuse miliare*, ALIBERT; *Gutta Rosea hereditaria*, DARWIN.

This affection, as might be inferred from its designation, is the most simple of all the varieties of acne. The pustules which appear at first like very small points or granules, are usually sparse and distinct, not being connected by any intermediate inflammatory affection of the skin. They manifest themselves in the sebaceous follicles of the chin, forehead, sides of the nose, angles of the jaws; do not break out all at once, but appear consecutively, without pain, or even tenderness, and seldom at first occasion any other feeling than a slight crawling sensation. When the eruptive points proceed to suppuration, the process is very gradual, the accumulation of pus seldom appearing under two weeks, when they burst and contract, the thin contents drying into very minute crusts. Many of the eruptive points do not arrive at suppuration, but subside in the course of eight or ten days. Larger crops of the eruption may exist at one time than at others, but each pimple appears to run a separate and, as it were, an independent course. In persons strongly predisposed to this form of acne, although there may be intervals of abatement, the eruption never wholly disappears spontaneously, until that change takes place in the constitution which is effected by the advances of maturity. As, during the presence of this eruption, the general health is usually better than common, its appearance would not seem to be indicative of any organic derangement, but rather of a certain development and vigour of the generative function, as already mentioned. This, with all other forms of acne, are undoubtedly aggravated by the use of gross and stimulating food and drinks, and, in general, whatever tends to deprave digestion. But the same observation is applicable to all other diseases, whether local or general, acute or chronic. The constipation which is so frequently mentioned as a strong promoting cause of acne, we are disposed to regard, as for the most part, an effect of certain derangements of the stomach and bowels, produced by improper living.

2. *Acne punctata. Varus*, Latin; *Tannes*, Fr.; *Grubs*, or *maggot-pimple*, Eng.

This species of acne derives its distinctive appellation from the black points that project from the centres of the pustules, which points are evidently produced by a thickening of the sebaceous secretion occasioned by the inflammation of the follicles. When pressed out, they appear like small grub-worms, or maggots, with black heads, and are often really considered as such, by the uninformed, who are not aware that the sebaceous matter secreted by the cutaneous follicles is moulded into this vermicular shape by the glands in which it is deposited. The most ordinary seats of acne punctata are the sides of the nose and the adjoining parts of the cheeks. It occurs also, very often, upon the forehead and chin. The inflammation sometimes extends to the production of pus, by which the dilatation of the follicles is greatly increased. This variety of acne is often found united with acne simplex, as represented in Bateman's *Delineations*, Plate LXII.

3. *Acne sebacea*, is a species introduced by Biett, whose own description makes it amount rather to an excessive secretion and exudation of the ordinary sebaceous matter, than to a distinct morbid lesion seated in the follicles. "Sometimes," says this author, "this fluid spreads itself over the skin, giving it a greasy look; sometimes, by thickening, it acquires a scaly appearance, being softish, slightly adherent, and very quickly taking on a blackish colour." It is doubtful whether the affection thus described by Biett, will in future stand its ground as a distinct species of acne. It has been noticed by other writers upon cutaneous diseases, under the head of *morbid secretions of the sebaceous follicles*. (See Rayer, Vol. II. p. 246.)

4. *Acne indurata. Dartre pustuleuse disseminée*, Alibert; *Stone-pock*, Eng.

In this affection, which is one of the most strongly marked, frequent, and obstinate of the several species of acne, the eruptive points are larger, more indurated, of a brighter red, seated nearer together, and more sensitive than the varieties of acne yet described. The inflammation of the skin is deeper seated, extending even through this tissue, so as to involve the cellular texture beneath; thus strongly resembling furunculi. The pustules are of conical shape, with hard and thickened bases, and so indolent, that several weeks elapse after their first appearance before suppuration is apparent. They are often clustered together in patches, so as almost to form a flattish tumour. In some cases, and more especially when the subjects possess the sanguineous temperament with vigorous health, this eruption is often attended with considerable inflammation; which condition is exasperated by every departure from a strict regimen, or, in fact, by any circumstance which produces local or general excitement. After having attained to maturity, most of the pustules not unfrequently decline suddenly, leaving on the places they occupied, a

livid hue and depressions which are sometimes long in disappearing, and occasionally are never completely obliterated. The severest cases are generally met with in young men who have a thick and greasy skin. The general health seldom appears to suffer from the presence of acne indurata. During the existence of acute febrile or inflammatory attacks, as well as when the system is under the influence of a mercurial course, the eruption will generally entirely disappear, returning, however, almost invariably with the subsidence of these conditions. On this account, their reappearance is regarded as a symptom of convalescence. BATEMAN has delineated this species of acne in his LXIII. plate.

5. *Acne rosacea*, Gr.; *Varus*, Lat.; *Herpes pustulosus*, *Gutta rosea*, Auct. var. *Dartre pustuleuse couperose*, ALIBERT; *Saphir*, *Goutte rose*, *Couperose rougeurs*, Fr.; *Rosy drop*, *redpimpled* or *carbuncled face*, Eng.

Acne rosacea commonly developes itself at a more mature age than the preceding species. It usually commences with a redness at the end of the nose, which redness subsequently spreads so as to involve the whole lower part of this organ, and extend some distance upon the cheeks. ALIBERT thinks this affection more commonly found upon the right side of the nose than upon the left, ascribing as a cause the seat and influence of the liver. The skin becomes red and injected, especially about the pimples or pustules, which, though few and small at first, gradually multiply, and are frequently renewed. The seat of the eruption at length becomes tumid, the redness remaining permanent, adding to the disease an erythematous character. The minute blood vessels, from frequent and long continued distension, become enfeebled, and the circulation being impeded, the parts affected acquire a bluish or livid appearance, often becoming exceedingly enlarged, and studded with granulated tumours having a shining surface; the expression of the countenance is altered to one less agreeable, and sometimes even hideous and disgusting. In this last aggravated stage, not only the cutaneous structure is involved, but the whole of the tissues which it covers. The seat of the affection is observed to be quite pale early in the morning, increasing after eating, or as the day advances. The heat, redness, and tension which often add so much to the annoyance, are increased by everything which contributes to the general excitement, especially full repasts on high-seasoned food or stimulating drinks.

Treatment. The several varieties or species of acne, taken in the earliest stages, are generally controllable under proper treatment. But most of the cases in which the physician is consulted, have been suffered to assume aggravated forms, and, indeed, often been driven into such conditions by the injudicious application of popular remedies, among which the saturnine lotions and ointments are deemed the most injurious. The patient seldom thinks it worth while to consult a physician about so apparently slight a matter as a few minute pimples, which often occasion neither pain nor uneasiness; and when he does apply for medical advice, can rarely be induced to conform to the restrictions and other directions enjoined upon him. Hence, for the most part, the apparently rebellious and even intractable character of some of the varieties of acne.

The authorities upon the subject are much divided in regard to the treatment proper to be pursued; some believing that the disease is at all times a "chronic pustular affection," (CAZENAVE,) whilst others regard it as a regular phlegmasia. One party directs stimulating applications from the first, whilst the other employs them only at a more advanced period of the disease. Experience proves that in many cases, in their incipient stage, the morbid actions of the cutaneous texture can be removed by local applications, which modify these actions, or substitute others that eventually take the place of the first. But in a more advanced stage, where the morbid actions have become confirmed, or where there is a natural or accidental irritability of habit, the use of applications calculated to produce excitement has been attended with serious danger, by aggravating the original disease, or by producing violent erysipellatous inflammation, or some other formidable affection. It is, therefore, evident that the proper treatment of acne calls for much discrimination in the application of remedies, which should be adapted to the stages of the disease, and to the constitutional circumstances of the patients.

1. *Acne simplex*, before it has lasted sufficiently long to induce any deep alteration of the skin, and whilst the pustules are as yet thinly scattered and surrounded by little or no redness or inflammation, will often yield to local and general treatment. A regimen should in most cases be adopted, consisting, for the greater part,

of the most wholesome vegetables and fruits, milk, and a very moderate use of the lean parts of the lightest and most digestible meats, such as chicken, mutton, and beef, plainly cooked. A careful abstinence should be observed from all articles of food of a gross or indigestible nature; which last are so very numerous as to render their particular designation a tedious task. Rich pastry, cakes, nuts, puddings, gravies, salted and cured meats, and fish, are some of the most common of the forbidden articles. The use, two or three times a week, of moderate doses of Epsom salts and the calcined magnesia, either taken alone or together, will be found to lessen the predisposition or expedite the removal of simple acne. A mixed powder, consisting of magnesia, rhubarb, and sulphur, in proper proportions, may also be employed with the same views. The internal use of the sub-borate of soda, either in the form of pill or draught, combined with camphor, the extracts of taraxacum or rue, are also highly recommended by some authors. In delicate females, the pilula aloës cum myrrha, either alone or combined with the pilula ferri composita or extractum gentianæ, are administered for the purpose of restoring the proper actions of the lower bowels and uterus. Along with this dietetic and medical treatment may be conjoined local applications, consisting of washes and ointments. Lotions composed of some of the distilled aromatic waters, most frequently those of the rose and elder-flower, with the addition of from a sixth to an eighth part of alcohol, are strongly recommended by some of the best French authorities, who also add to them occasionally about half a grain of the oxymurias hydrargyri to the fluid ounce. In England, Gowland's lotion has long been a popular remedy for this eruption. Its active principle is well known to depend upon the mercurial salt last mentioned dissolved or blended with the emulsion of bitter almonds.

Cerates or ointments containing one or more of the mercurial preparations often prove serviceable. The sub-muriate and red precipitate, for example, either alone or mixed, and formed into an ointment, frequently prove admirable external remedies. The cerates may be applied at night, and the lotions two or three times during the day. An ointment composed of ammoniacal protochloride of mercury, in the proportion of a scruple or drachm to an ounce of axungia, is highly recommended by Cazenave, who remarks, that the addition of the ammonia to the calomel appears absolutely necessary to obtain a favourable result. Saturnine ointments as well as washes, though frequently recommended, are thought to predispose to, and promote this cutaneous affection, rather than act as remedies.

In addition to the washes mentioned, the following are likewise recommended by high authorities: The liquor ammoniæ acetatis, or spiritus mindereri, and the pyroligneous acid diluted with rose or elder-flower water; solutions of the sulphuret of potass in the proportion of ʒj to 12 or 16 ounces of water; or of muriate of ammonia, either alone or combined with the oxymuriate of mercury. Solutions of the sub-borate of soda in rose or elder-flower water, or in a liquid prepared by pouring water in a boiling state over sulphur and allowing it to infuse for 10 or 12 hours, are recommended as forming highly advantageous lotions, generally applicable to the varieties of acne. In the more chronic cases, the solution of the last named salt in elder-flower water with the addition of honey, is also recommended as a good lotion. The same may be said of washes made of muriatic acid, ʒj to ℥vj of water, and of the liquor potassæ in the proportion of ʒj or ʒij in ℥viij of water. Washing the face frequently in bran-water, prepared by passing warm water through bran placed in a colander, seive, or coarse cloth, will always be found highly serviceable. Warm milk, the emulsion of bitter almonds, and decoction of quince seeds, are all found serviceable as external applications. All the ancient physicians who have treated of these cutaneous affections, have recommended the emulsion of bitter almonds.

Blood-letting, which is thought by some authors so essential in the treatment of this and other varieties of acne, is, we think, seldom or never advisable, except under very peculiar circumstances; as when the subjects of the eruption complain of pain and distension about the head, or more especially when the eruption occurs about the menstrual period in girls of the sanguineous temperament. Moderate blood-letting may, under such circumstances, be not only allowable but advisable.

2. In the treatment of *Acne punctata*, more vigorous measures, both local and general, are usually demanded. The most steadfast attention must be given to the observance of a light but nutritious regimen, such as has been already recommended for the treatment of acne simplex. In the early stages, advantage may like-

wise be derived from the use of gentle laxatives, repeated every second or third day. Those recommended in the treatment of the preceding variety, will perhaps be as useful as any others.

As a mild and refreshing beverage, whey is recommended; and with the French, an infusion of chicory or endive is a very popular drink in this affection. Bleeding, either local or general, is insisted upon, by Cazenave and others, as almost indispensable to the successful management of acne punctata. But, except under the peculiar circumstances already stated, we think blood-letting by no means so imperiously called for as has been implied.

The same washes and ointments recommended for acne simplex, will be found useful in the treatment of acne punctata. It will, however, be generally necessary to increase their strength and apply them more freely. But previously to having recourse to these, the inflammation of the pustules should be allowed to subside under a proper course of regimen, laxatives and emollient washes, or other applications having the same tendency; after which the resolution of the tubercles may be accelerated by the measures referred to. Ointments, the basis of which consist of the proto-chlorurets of ammonia, the proto-sulphurets of mercury, proto-ioduret and ioduret of sulphur in the proportion of from 12 to 24 grains to the ounce, are highly recommended by Biett, who, however, thinks them improved by the addition of a small quantity of camphor. Solutions of the chlorides of lime and soda —about ℈ij to ℥xij or ℥xvi of water—have also been found useful in many cases of acne punctata. These applications, when first used, will frequently occasion more or less irritation, according to their strength or the irritability of the parts affected. Should this be considerable and not transient, they should be laid aside for awhile to allow the increased actions to subside, which will take place sooner if the bran-water or some other emollient wash is resorted to. After this the eruption will generally be found better. The application, when again recurred to, will seldom be felt so sensibly, or occasion so much uneasiness as at first.

Most authors recommend the extraction of the black points from the subaceous follicles, by pressing these on both sides with the finger-nails, and, after thus starting them, pulling them out with curved blunt forceps contrived for the purpose. It is, however, questionable whether much advantage is ultimately derived from such a course, for so long as the disposition remains on which their formation depends, the points will be renewed almost as fast as removed. The mechanical means, therefore, if resorted to at all, should be used very gently and cautiously, so as to cause as little fretting and irritation as possible.

3. In the affection called by Biett *Acne sebaceæ*, the morbid secretions of the sebaceous follicles can generally be corrected by the use of lotions of diluted alcohol, which may, in some cases, require the addition of a small quantity of the liquor potassa, or from 6 to 8 grains to the ounce of the sulphuret of potass.

4. *Acne indurata* calls for a treatment, both local and general, very similar to that described as applicable to acne punctata. The recourse often had by unprofessional, and sometimes even by professional persons, to the employment of frequent and active purgatives, under the antiquated notion of removing some supposed impurities of the blood, is mistaken in a pathological point of view, and often tends to aggravate the disease, both in this and the preceding varieties. Gentle laxatives, such as operate without perceptibly diminishing the strength either of the digestive organs or system generally, are all that can be resorted to with propriety. A constipated state of the bowels is so often attendant upon acne, as to be regarded by most writers among its chief exciting causes. This condition may, as we have said, call for the use of aperients, but never, as we think, can justify active purgation.

As acne indurata is usually attended by more strongly developed inflammation in the cuticular tissue than the preceding varieties, stimulating applications should be more cautiously used. When the pustules are so numerous as to be almost confluent or united at their base, not only affecting the whole depth of the skin, but even penetrating into the cellular structure beneath, precaution is the more necessary, particularly in young persons of the sanguineous temperament. Biett says, that in a great many instances of this kind he has derived the most prompt and favourable results from general bleedings, and repeated applications of leeches behind the ears, temples, and sides of the nose.

It is only after the subsidence of the active inflammation, that stimulating applications can be properly resorted to for the resolution of the tubercles. As a vehicle for the chloride of mercury, borax, and some other substances employed in

the preparation of lotions for this and other varieties of acne, the emulsion of bitter almonds, or the camphor mixture with the addition of about 12 minims or drops of the hydrocyanic acid to each fluid ounce, are highly recommended by THOMPSON and other distinguished practitioners in cutaneous diseases.

To promote the resolution of the tubercles upon the subsidence of the inflammation, BIETT and after him CAZENAVE, recommend the following ointment:

℞. Sub-murias Hydrarg. et ammoniæ, ℈j to ʒj; Axungia recentis, ℥j; Mice ft. Unguentum.

The sub-murias hydrarg. et ammon. is prepared by subliming equal parts of corrosive sublimate and muriate of ammonia.

UNDERWOOD and WILLAN recommend as internal remedies both the carbonate of potass and oxymuriatic acid. Dr. THOMPSON states, that, after regulating the bowels, he has known the skin completely cleared of the eruption by using, for about six weeks, the following alkaline tonic:

℞. Zinci sulphatis, gr. xxiv; Liquor Potassæ, f. ℥iſs. M. Dose about 30 drops in a glass of water.

BATEMAN speaks favourably of small doses of sulphur, soda, and antimony, internally, and recommends, as an external application, an ointment prepared with the white precipitate of mercury in the proportion of from ℈j to ʒj to the ounce. In England the sulphurous waters of Harrogate and similar springs are much resorted to for these and other cutaneous affections. The sulphurous fumigations afford a valuable external remedy, but are difficult of application to the face. They may, however, be applied by means of a paste-board tube or pipe, two or three inches in diameter, one end of which is connected with a furnace or some other contrivance proper for generating the fumes, and the other extremity held alternately upon those parts of the face on which the eruption is seated. The time necessary to effect this makes the operation rather more tedious than many persons will submit to.

In the writings left us by the ancient physicians, we find, in addition to the emulsion of bitter almonds, various other articles recommended as external applications for the varieties of acne; such as liniments prepared with honey and vinegar, and various preparations containing myrrh, and the terebinthinates, alum, soap, the cimolean earth, the bruised roots of certain plants, such as the lily, narcissus, cyclamen, and the fruit of the wild vine.

5. In the varieties of acne hitherto considered, there has appeared more or less affinity in one or other of the stages; but *Acne rosacea* seems to differ from all others in many respects, and, as it were, to stand alone. The other varieties most frequently manifest themselves in early puberty, and, as we think, are without any apparent primary connexion with disorders of the viscera. *Acne rosacea*, on the contrary, seldom appears in very early life, except where the predisposition is very strong, but manifests itself at mature age, when it is commonly connected with decided morbid conditions of some of the abdominal viscera, such as chronic irritations of the stomach, chronic hepatitis, deficient or irregular menstrual evacuations, suppression of habitual hemorrhoidal discharges. As this variety of acne is, therefore, usually associated, either with general derangement of the system or is sympathetic of some organic lesion, local applications will seldom succeed in its removal. They are, on the contrary, frequently prejudicial, by aggravating the complaint. When the use of astringent and other applications has occasionally succeeded in repressing the eruption previously to the employment of measures calculated to restore the healthy state of the chylopoietic or other organs, the deranged condition of these will be very liable to be aggravated.

If the appearance of the eruption indicates blood-letting, this should in almost every instance be local, by means of leeches applied near the parts affected. This kind of depletion is particularly called for when the eruption occurs in females at the critical period, or about the cessation of the catamenia. The regulation of the diet, so essential an object in the treatment of the other varieties of acne, is here more imperiously called for, as, without the strictest temperance in both eating and drinking, no benefit can be expected from any remedies employed. Where the stomach and liver have been disordered, advantage has been derived from the use of antacids, particularly the liquor potassæ. BIETT speaks of the success which has followed the use of calomel administered so as to produce slight tenderness of the gums, in cases where acne rosacea was associated with chronic hepatitis. The question is, whether any permanent advantage can be expected from such a practice; for it is commonly observed, that where any of the varieties of acne disappear under the influence of

mercury, they revive again as soon as that influence has subsided. The same author observes, with respect to the boasted advantages said to be derived from the employment of emetics and drastic purgatives, that, in general, such irritating medicines cannot be too moderately used, since what is often called torpor of the alimentary canal, is more frequently the consequence of deep-seated chronic inflammation, than actual debility. He therefore thinks, that excitants of every description should be positively forbidden, and that advantage can only be expected from the use of mucilaginous drinks, with a rigid diet. Whatever may be thought of this pathological reasoning, there will probably be little difficulty in admitting the conclusion as to the absolute necessity of strict regimen, without which, the most boasted remedies will be found of little or no efficacy. And not only should every kind of excess in eating or drinking be avoided, but a diet adopted, consisting of farinaceous articles, with a very moderate quantity of light nutritious animal food, and toast-water, whey, and barley-water, for drinks. The good effects of regimen will be assisted by gentle exercise, and whatever tends to promote the healthy actions of the abdominal viscera and cutaneous tissue.

As an alterative and deobstruent in this form of acne, pills according to the following formula are highly recommended:

℞: Pil. Hydrarg. sub-mur. comp. ℈j; Fellis Tauri Inspissat. gr. xv.; Sapon. Castil. gr. x.; Ext. Taraxici ʒj.; M. fiant pil. No. xviij. Two or three of these may be taken at bed-time. The hydrarg. cum creta, with soda and taraxicum, are also recommended for the same purpose. The dulcamara, in decoction or extract, the liquor potassæ, and externally the chlorine and sulphurous fumigating baths and douches, are also highly advantageous remedies in many cases of acne rosacea.

Hitherto the subject of baths, both natural and artificial, has been left almost untouched, since, as these have been found more or less advantageous in all the varieties of acne, it appeared most convenient to introduce the subject after these had been specially treated of.

In Europe, the more obstinate varieties of acne are said to be often much benefited by the employment of the natural sulphurous waters, such as those of Harrogate in England, Barége in France, and Aix in Savoy. These are taken more or less freely internally, used as general baths, and applied to the parts affected, as washes or douches. The last mentioned mode consists in directing a stream or jet through a proper tube, to which a rose, like that of a watering-pot, is often adapted, so as to occasion a scattering of the water. Natural fountains of sulphurous waters are very abundant in our own country, especially in the state of Virginia, where they are found in such great variety as to temperature and quality.

But as few cases of acne are of such importance as to justify a recourse to measures so inconvenient on many accounts, there are, happily, artificial means which may be taken advantage of, to supply, in a great measure, the place of the natural ones. These consist of the application of vapour in baths and douches, similar to those so generally used in Paris, and which Biett says he has tried for several years most extensively in the St. Louis Hospital, that great receptacle for cutaneous diseases of every variety. The douche or jet of vapour is usually directed from twelve to fifteen minutes upon the various parts on which the eruption exists. The immediate effects are, an increased activity of the cutaneous circulation, with increased warmth, soon followed by a starting of the perspiration. But this active determination is quickly succeeded by a striking subsidence in the actions of the parts affected, which, in a few hours, become less hard and smoother to the touch. The induration of the follicles is thus softened and resolved, and the dermoid tissue gradually returns to its natural healthy state. These vapour douches may be employed when the eruption is only slight, or where it appears in its most aggravated forms. But, in the last case, Biett precedes their use by local bleedings, and such emollient applications as are calculated to combat local congestion, until the subsidence of which the employment of douches should not, in general, be commenced.

The baths of aqueous vapour exert very similar effects, but their action is more general and energetic, for which reason they should be used in those cases only where there is sufficient constitutional vigour to resist their tendency to produce determinations to and congestions in the breast and head. The employment of these vapour-baths and douches, under the regulations prescribed, is often alone sufficient for the removal of the most obstinate cases of acne.

Every one who has had much experience in the treatment of these cutaneous affections, must be aware of the fact, that, to procure permanent cures, the means

employed must be continued for some time after the eruption is apparently subdued. It is during this after-treatment, that BIETT recommends the employment of lotions of warm milk, emulsion of bitter almonds, decoction of quince-seeds, etc.; but, as more particularly efficacious in restoring the skin to a natural state, the cold sulphurous waters of natural springs applied in douches or showers.

G. EMERSON.

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I. H.

ACONITE. (*Mat. Med.*) *Wolfsbane, Monkshood. Aconitum,* U. S. Ph.; *Aconit,* Fr.; *Eisenhut, Mönchskappe,* Germ.

This medicine is the product of various species of *Aconitum,* particularly of the *A. Napellus,* all parts of which are possessed of active properties. (See *Aconitum.*) The leaves are the portion kept in the shops, and recognized as officinal in the Pharmacopœia of the U. States, and by the British colleges. They should be collected after the stem has attained a considerable elevation, at or immediately before the period of flowering.

Sensible properties, composition, &c. The fresh leaves have a faint narcotic, somewhat nauseous odour, which becomes more sensible when they are rubbed or bruised. Their taste is at first bitterish and herbaceous, afterwards very acrid. When chewed, they excite a severe burning and tingling sensation in the tongue, lips, and palate, which is attended with a considerable flow of saliva, and often continues several hours. The tongue is sometimes affected with a feeling of numbness. The recently dried leaves retain the acrimony of the fresh, but it is not so soon developed in the mouth and fauces. By long keeping, both their sensible properties and medicinal activity are impaired. The root is said by some writers to be even more acrid than the leaves. The virtues of aconite are thought to reside in an acrid principle, the nature of which, however, has not been satisfactorily ascertained. STEINACHER considered it volatile; and this view of its character would seem to receive confirmation from the experience of BUCHOLZ, who was affected, during the bruising of the fresh herb of the *A. Neomontanum,* with headach, vertigo, tremours, and pain in the back. If not volatile, the principle is certainly injured by heat; as the extract prepared by boiling the decoction to dryness is comparatively inert; and SOUBEIRAN found the alcoholic extract much less poisonous than the tincture from which it was prepared. The German chemist BRANDES considers the active principle to be an organic alkali; but his experiments were imperfect, and his conclusion by no means satisfactory. PALLAS obtained from the root of the *A. Lycoctonum* a very bitter substance, in the form of yellowish scales, which he found to have an alkaline reaction. The quantity, however, which he procured, was too small to admit of a thorough examination of its nature and properties. Should the active principle prove to be a peculiar alkali, it would be entitled to the name of *Aconitia.* The virtues of aconite are completely extracted by diluted alcohol.

Signs of quality, adulterations, &c. The dried leaves should be of a green colour, paler on their under surface, should possess the acrimony of the plant in a high degree, and should be free from mustiness. If brown or very light coloured, they may be considered inferior, and if tasteless, should be rejected as inert. The leaves of other species of *Aconitum* are often substituted for those of the *A. Napellus,* but without disadvantage, if possessed of the same sensible properties. The leaves of the *Delphinium elatum,* Linn., which are also said to be occasionally substituted, are a real adulteration. They may be distinguished by their incisions being less deep, and by being hairy beneath, while the leaves of the *A. Napellus* are smooth. The shape of the latter, which will afford one criterion of the genuineness of any specimen under examination, may be learned by consulting the description of the plant. (See *Aconitum.*)

Effects upon the system; toxicology. Aconite is an acrid, stimulant narcotic, possessing diaphoretic and diuretic properties. Applied externally, in the fresh state, it inflames the skin, and will even

produce blisters, if the application be long continued. (BICHAT, quoted by MERAT and DE LENS.) Taken internally, in quantities sufficient moderately to affect the system, it excites the circulation, and, under favourable circumstances, gives rise to sweating, which may be sustained for a considerable time. By keeping the skin cool, its action may often be directed to the kidneys, which it stimulates to increased secretion. It sometimes also purges. Together with these effects upon the secretory functions, it produces more or less vertigo, or other cerebral disturbance, with deranged sensations about the throat, and occasionally a feeling of tingling in the tongue. In the quantity of one or two drachms, it acts as a violent poison. Numerous instances are on record of fatal effects arising from its incautious use. The symptoms produced, are burning heat in the stomach, ardent thirst, gastric and intestinal spasms, vomiting and hypercatharsis, disordered respiration, vertigo, delirium, coma, tremours, convulsions, tympanitic abdomen, cold sweats, and great prostration, succeeded by death. Dissection reveals effusion into the ventricles of the brain, a congested state of the lungs, and marks of inflammation without ulceration, in the stomach and small intestines. The latter appearances, however, are not always present; and the probability is, that death results from the impression of the medicine upon the nervous system, not from its local effects upon the alimentary canal. In a dog which died in consequence of having been compelled to swallow the extract of aconite, ORFILA found the lungs congested, but the brain and digestive canal in a healthy state. From the experiments of BRODIE it appears, that the poisonous influence of aconite is experienced as well when it is injected into the rectum, or applied to the cellular membrane, as when it is taken into the stomach. A case is on record in which the juice of the plant, by coming in contact with a small wound of the thumb, produced cardialgia, much anxiety, a sense of suffocation and faintness, with great pain in the hand and arm, and ultimately mortification of the part. From what has been stated, there can be little doubt that aconite, while it produces more or less local irritation, is, at the same time, absorbed, and, entering the circulation, acts immediately upon the brain and nerves. The poisonous effects are best counteracted by emetics, and the free use of demulcent beverages. Should the brain evince signs of much excitement, or the stomach of inflammation, bleeding from the arm, or by leeches, may be necessary, and blisters or sinapisms may be resorted to as revulsives. In cases of great prostration, after the evacuation of the poison, a cordial treatment may be requisite.

Therapeutic use. The ancients were acquainted with the poisonous properties of aconite; but it is thought by many botanists that they confounded together several plants under this name. STÖRCK was the first who, in modern times, called the attention of physicians to it as a remedy. Having, by experiment upon his own person, found the extract to produce a sustained perspiration, he was induced to try it in various diseases, in which this effect is indicated as the means of cure. In these attempts, he met with such success as to convince him of the importance of the remedy; and, in the year 1762, he published a work in which he recommended its use, and supported his recommendation by the statement of successful cases. Since that period, many other physicians in Germany, Italy, and France, have borne concurrent testimony in its favour; and it is now universally ranked among the standard officinal remedies. In this country, however, it is comparatively little employed, in consequence, probably, of the variable and often almost inert condition of the medicine as it reaches us.

The disease in which it has been found most useful, is chronic rheumatism. In this complaint it was strongly recommended by STÖRCK, who cured with it several inveterate cases, which had resisted other powerful remedies. Equal success was afterwards obtained by other physicians, particularly in Germany. Among those who found it decidedly beneficial in rheumatic affections were MURRAY, ROSENSTEIN, and COLLIN; and the testimony in its favour from numerous sources is too strong to admit of reasonable doubt as to its occasional efficacy. According to the experience of the late Dr. DUNCAN, of Edinburgh, who gave it successfully in several cases of sciatica, "its effect in suspending pain was always accompanied with a tingling sensation in the affected part, sometimes increasing to such a degree, as to render the intermission of the remedy necessary." It probably acts by a combination of its narcotic and diaphoretic properties, relieving pain temporarily by its direct influence on the nerves, while it tends to eradicate the complaint by establishing a revulsive tendency to the skin. It may possibly, also, act as an alterative, changing, in some inexplicable manner, the morbid condition

of the nerves and capillaries. It must be confessed, however, that Professor Fouquier, who experimented largely with aconite in the *Hôpital de la Charité*, did not find it to produce the same happy results in this complaint as had attended the practice of some other physicians.

It has been employed in gout, and was highly esteemed as a remedy in this complaint by M. Royer-Collard, who thought that he had succeeded in keeping off the paroxysms by its use in his own case; but it has been suggested, that if this advantage were really experienced by him, it was more than counterbalanced by the substitution of that long train of irregular gouty disorders under which he ultimately sank. Murray was of opinion that arthritic depositions might sometimes be resolved by its long-continued use; but his experience was limited to a single case.

In the painful rheumatic affection attendant or consequent upon secondary syphilis, the remedy has been found useful. Borda, an eminent Italian physician, speaks very favourably of its power in this affection; and Dr. Eberle, of this country, states, that he has had reason to be satisfied with its effects administered as an anodyne at bed-time. Its use has even been extended to other forms of syphilis. Brera prescribed it with apparent advantage in syphilitic ulcers, and M. Trousseau found venereal tumours give way under its employment; but in both these cases, it was combined with some mercurial, which was probably the real agent of cure.

Instances of its good effects in scrofulous and other chronic tumours and ulcerations, venereal nodes, and even in schirrous affections, have been reported. Such reports, however, are to be received with caution. In cancer, though recommended by Störck, it is utterly inefficient; and in the other cases alluded to, its favourable influence was probably limited to an alleviation of pain, and to a feeble co-operation either with other more effectual remedies, or with the natural tendencies of the complaint to a spontaneous cure.

Evidence is not wanting of the efficacy of aconite in consumption. Over the tubercular form of the disease, however, it can exercise no salutary control. M. Portal, who was induced to think that it might be useful, soon relinquished it. Dr. Busch, in a work published at Strasburgh, strongly recommends it in phthisis. He gave the powder in the quantity of two grains every two hours, augmenting the dose every day, till the disease began to give way, which seldom failed to happen. Sometimes he proceeded so far as a drachm during the day, but not frequently, as success rendered such an increase unnecessary. The species employed by him was the *A. Cammarum.* His cases were probably catarrhal consumption, or chronic bronchitis, in which the medicine would really appear, from the testimony of Borda, to exercise a beneficial influence.

Its diuretic properties would naturally lead to the inference that it might be useful in dropsy; and Professor Fouquier, of Paris, met with considerable success from it in the treatment of cases of this complaint of a passive character. It had previously, according to the testimony of De Candolle, been used as a popular remedy in dropsical swellings by the peasants of the Alps.

Other complaints in which it has been employed, are amaurosis, spasmodic closure of the iris, uterine pains, and intermittent fever; but in all these affections, it is so much inferior to other remedies, that it scarcely merits notice.

Dose, form of administration, &c. Aconite may be given in the form of powder, extract, or tincture. In every form, however, it is so uncertain in strength, that the dose should be small at first, and gradually increased either till the desired effect is obtained, or the system evinces unequivocal evidences of its operation.

Of the powdered leaves, one or two grains may be given two or three times a day, and gradually increased, if necessary, till the quantity administered in twenty-four hours amounts to a drachm or more.

The extract prepared by carefully evaporating the expressed juice, as directed in the U. S. and British Pharmacopœias, was generally employed by Störck. It is often an active preparation, but varies exceedingly in strength. The dose is from half a grain to a grain, to be repeated and increased, as in the case of the powder. The extract made by evaporating a decoction of the leaves, is, according to Orfila, almost inert. The alcoholic extract is more powerful than either of the preceding preparations, and requires to be given in a somewhat smaller dose. It is not, however, officinal.

The tincture is, perhaps, the most certain preparation, as it may be made from the leaves before they have been deteriorated by keeping, and is less liable than the extract or the leaves themselves, to undergo change with time. It is prepared

by macerating two ounces of the dried leaves in a pint of alcohol, and may be given in a dose of ten or fifteen drops.

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GEO. B. WOOD.

ACONITUM. (*Botany.*) ACONITE.—*Monkshood, Wolfsbane. Aconit,* Fr.; *Eisenhut,* Germ.

Sex. Syst. Polyandria Trigynia. *Nat. Ord.* Ranunculaceæ.

Gen. Ch. "*Calyx,* none. *Petals,* five; the upper vaulted. *Nectaries,* two; hooded, stalked, recurved. *Siliques,* three or five."—LINDLEY. By some botanists the corolla is considered as a coloured calyx, and the nectaries as the true corolla.

The plants composing this genus are perennial and herbaceous, with stems from two to six feet in height, furnished with digitate or palmate leaves, and terminating in spike-like racemes, or panicles, of conspicuous yellow or violet-coloured flowers. The limits of the different species do not appear to be well defined, some botanists considering as distinct plants what others admit only to be varieties. Hence has arisen a confusion of nomenclature which is often perplexing, and which sometimes renders it impossible to decide to what species authors refer in their accounts of the properties of Aconite. There has even been considerable uncertainty as to the particular species which should be considered officinal. STÖRCK, who introduced the medicine into notice, speaks of the plant employed by him as the *A. Napellus,* and hence this species came to be generally introduced into the officinal catalogues. But the figure of STÖRCK's plant was not found to correspond with the *A. Napellus* of LINN., but with another species, described by WILLDENOW under the name of *A. Neomontanum,* and considered, at present, as a variety of the *A. Cammarum* of LINN., or the *A. Paniculatum* of DE CANDOLLE. The latter species has, therefore, of late, been generally considered as the plant used by STÖRCK, and is recognized as officinal in the last edition of the United States Pharmacopœia. But STÖRCK speaks of the plant with which he experimented as possessing an extraordinary degree of acrimony, producing, when applied to the tongue, even in the dried state, a very severe and long-continued burning, attended with a flow of saliva. Now we are assured by GEIGER, in his Manual of Pharmacy, that he has always found the *A. Neomantanum,* as cultivated in the gardens, comparatively mild to the taste; and the same observation was made by BUCKNER. That this want of acrimony was not owing to the domestication of the plant, was inferred from the fact that the *A. Napellus,* growing along-side of it, had a very burning taste; and this difference between the two species was found to be constant, in every situation in which they were examined. Hence it is conjectured by GEIGER, with whom HAYNE concurs, that the figure in STÖRCK's work was probably drawn from a different plant from that which he actually used. DE CANDOLLE considers the variety *Störckianum* of his *A. Paniculatum,* as the plant employed by that celebrated physician. But more weight has, perhaps, been attached to this question than it really deserves. Most of the Aconites have similar medical virtues, which may be considered, in the different species, as proportionate to their respective acrimony; and it is of little consequence which was the particular plant that formed the subject of STÖRCK's experiments. The leaves of various species are, in fact, indiscriminately collected and kept in the shops; and the value of any particular specimen must be judged of, not by the species from which it was derived, but from the degree in which it possesses the peculiar sensible properties of the medicine. If, however, any one species is to be selected as officinal, that should be preferred which possesses, under all circumstances, whether wild or cultivated, the most acrimony; and GEIGER states, that the *A. Napellus* of LINN. is superior, in this respect, to all those tried by himself. In the Paris Codex, the *A. Anthora, A. Cammarum,* and *A. Napellus,* are recognized as officinal; by the London and Edinburgh colleges, the *A. Napellus;* by the Dublin College, the *A. Paniculatum* of DE CANDOLLE; and in the U. S. Pharmacopœia, the *A.*

Neomantanum. We shall describe particularly only the *A. Napellus.*

A. Napellus, Linn. This is a perennial plant, with a turnip-shaped or fusiform root, which is externally brown, internally whitish and fleshy, and from its shape has given rise to the name Napellus, which signifies a little turnip. After the plant has shot into stem, there are usually two roots, one of which supports the plant, and is of a dark-brown colour, the other, standing by its side, is similar in form, but younger, and of a light-yellowish-brown colour, and sends up the stem of the following year. The stem is herbaceous, erect, round, leafy, usually simple, and from two to four or even six feet in height. The leaves are alternate, petiolate, divided almost to the footstalk, from two to four inches in diameter, deep green on their upper surface, light green beneath, somewhat rigid, and more or less smooth and shining on both sides. Those on the lower part of the stem have long footstalks, and five or seven divisions; the upper, short footstalks, and three or five divisions. The divisions are narrow at their base, but widen in the form of a wedge towards their summit, where they usually present three lobes, of which the middle is the longest, and all are cleft or toothed with linear, or linear-lanceolate and pointed laciniæ, or teeth. The flowers are of a dark violet-blue colour, large and beautiful, and are borne at the summit of the stem upon a thick, simple, straight, erect, spike-like raceme, beneath which several smaller racemes sometimes rise from the axils of the upper leaves. They stand upon short, somewhat erect peduncles, which are furnished with two short calycinal stipules, within a few lines of the flower. There is no calyx. The petals are five; the upper helmet-shaped and beaked, nearly hemispherical, open or closed; the two lateral, roundish and internally hairy; the two lower oblong-oval. They inclose two pedicelled nectaries, of which the spur is capitate, and the lip bifid and revolute. The capsules are from three to five in number, joined at the base, diverging at the summits, and inclosing several small, brown, inversely pyramidal seeds.

This species of Aconitum is a native of Europe, growing in the mountains, forests, and meadows of France, Switzerland, and Germany, and found also in Siberia. It is cultivated as an ornamental plant, and has been introduced into the gardens of this country; but, according to Ray and others, it loses much of its virulency when transplanted from its native mountains. Geiger, however, found it very acrid as growing in the gardens, and thinks that the accounts of the different powers of the wild and cultivated plant may be attributed to diversity in the species examined. The whole plant is acrid and poisonous; but the leaves are the part chiefly used. (See *Aconite.*)

Little need be said of the other species of Aconitum. 1. The *A. Anthora* is remarkable for its yellow flowers. Its root, which has a not unpleasant odour, and a bitterish acrid, somewhat sweetish taste, was formerly esteemed an antidote to the *thora*, whence the species derived its name, though it does not appear to be determined, whether the poisonous vegetable referred to was the *Aconitum Napellus*, or *Ranunculus Thora*, or some other plant. But the fact appears to be, that the *A. Anthora* possesses similar properties with the other species of Aconitum, though in a less degree. According to Linnæus, it is poisonous, vermifuge, and cathartic; and it has been used in Europe for the expulsion of worms. 2. The *A. Cammarum* of Linn. has attracted attention under the supposition that it was the plant used by Störck. It possesses similar properties with the A. Napellus, though probably in an inferior degree. The *A. Neomontanum* is a variety of this species, which includes also the *A. Paniculatum* of De Candolle. 3. The *A. Lycoctonum* has the peculiar acrid, narcotic, and poisonous properties of the genus. The root is said to be peculiarly poisonous. The plant derived its name from the circumstance that it was formerly used, like others of the genus, to destroy wolves. According to Dr. Martius, the root is used in Russia as a preservative against hydrophobia, being applied to the wound in the form of powder. The leaves of the *A. Lycoctonum* are said to be frequently substituted for those of the *A. Napellus.* 4. Dr. Wallich has recently published a description of the *A. ferox*, a native of Nepaul, the root of which is said to be extremely deleterious, and to have been used by the natives in times of war, for poisoning their weapons, and the springs of their country when invaded by an enemy. 5. The *A. Uncinatum* is the only described species indigenous in the U. States. It grows in the mountains of Virginia and N. Carolina; but its properties have not, so far as we know, been submitted to the test of experiment.

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Geo. B. Wood.

ACORUS. (*Botany.*)

Sex. Syst. Hexandria Monogynia. *Nat. Ord.* Aroideæ.

Gen. Ch. "*Spadix*, cylindrical, covered with florets. *Sepals*, six; naked. *Style*, none. *Capsule*, three-celled."—Lindley.

A. Calamus.—Sweet-flag, Calamus.—Roseau aromatique, Fr.; *Gemeiner Calmus*, Germ.—*Sp. Ch.* "Point of scape very long, leafy." Lindley. The root of this plant is perennial, horizontal, jointed, somewhat compressed, from half an inch to an inch thick, from two to four feet or more in length, externally of a whitish or greenish white colour; internally whitish and spongy, of an agreeable fragrant odour, and a hot, pungent, aromatic taste. The portions between the joints are short, usually not exceeding in length the diameter of the root, and are somewhat thicker at one end than at the other. At the joints are thickly set, short, slender, brown fibres, like coarse hair; and from the lower surface of the root proceed numerous round, yellowish or whitish radical fibres, which descend perpendicularly into the ground. The leaves are radical, two or three feet long, sheathing at the base, sword-shaped, smooth, green above, but of a reddish colour, variegated with green and white near their origin from the root. When bruised, they emit a fragrant odour. The scape, or flower-stem, which, in its upper portion, closely resembles the leaves, supports upon its side, near the middle of its length, a cylindrical spadix, tapering at each extremity, particularly towards the apex, two or three inches in length, and crowded with small greenish-yellow flowers. These are without calyx, and have six minute, concave, obtuse, almost truncated petals. The germ is elliptical, and supports a sessile stigma. The fruit is usually described as a three-celled capsule, containing numerous seeds. Hayne considers it a berry, which he describes as oblong, from three to six-sided, attenuated towards each extremity, having three compartments, and filled with a transparent mucilage. He ascribes the difference between other authors and himself to the circumstance that they have examined the fruit in an unripe state.

The sweet-flag is an indigenous plant, growing abundantly throughout the United States, in low, wet, swampy places, and along the sides of ditches and streams, and flowering in May and June. It is also a native of Europe and Western Asia; and a variety of the same plant grows in Malabar, Ceylon, and other parts of India. The Indian variety, distinguished in botanical systems by the name of *Acorus Calamus verus*, differs from the European, or *vulgaris*, in having a more slender root, which is also said to be more strongly and agreeably aromatic to the smell and taste. It is uncertain whether this, or the common variety, was the *Calamus Aromaticus* of the ancients; though it is probable that both were used. The conjecture of Guibourt that the plant of the ancients was the *Gentiana Chirayita* of the E. Indies, does not appear to have been sustained.

Though both the leaves and root of the *A. Calamus* are aromatic, the latter only is officinal. (See *Calamus.*)

Another species of Acorus, denominated *A. gramineus*, grows in China, where it is said to be cultivated for its agreeable odour.

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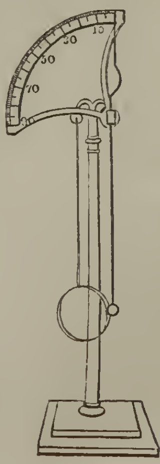
ACOUMETER. (From ακουω, I hear, and μετρον, measure.) An instrument devised by Itard to measure the degree of hearing.



It consists of a flat ring of copper. This is suspended from a quadrant graduated at its circumference, and to the angle of which there is attached a pendulum, terminated at its lower end by a ball; and having its upper extremity extended so as to form an index, which points out on the scale the distance that the ball is separated from the ring. The further the ball is drawn from the ring, the greater,

of course, will be the force with which the former will strike against the latter in its descent, and the louder will be the sound produced. A glance at the accompanying figure will give a perfect idea of the instrument; a more elaborate description is, therefore, unnecessary. This instrument enables us to determine exactly, not only the relative degree of acuteness or dullness of hearing of different persons; but also to ascertain the degree of improvement that may be effected by our treatment.

I. H.

ACOUSTIC, in general, denotes anything that relates to the ear, the sense of hearing, or the doctrine of sounds.

Acoustic Instruments, are certain mechanical contrivances devised to assist the hearing where that sense is defective. See *Deafness, mechanical means for correcting*. I. H.

ACOUSTICS. That branch of Natural Philosophy which treats of the nature of sound, and the laws of its production and propagation. It is interesting to the physician, as a knowledge of it is essential to the thorough understanding of the functions of the apparatus of hearing. I. H.

ACRANIA. (From α priv. and κρανιον, cranium.) Deficiency of cranium. See *Acephalus*. I. H.

ACRID. A term given, in general, to all substances which produce, in the organs of taste, a burning and irritating sensation, principally experienced at the top of the throat. Some vegetable, mineral, and animal substances possess this property naturally; several others acquire it by a peculiar alteration. They furnish condiments, medicines whose action is, in general, stimulant, and a class of poisons designated by the epithet acrid, or irritating.

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Renauldin. Dict. des Sc. Méd. Paris, 1812. Art. *Acre.*

I. H.

ACRIMONY. *Humorum acrimonia.* In the humoral pathology, acrimony of the humours played as important a part as is now accorded to irritation of the solids. All diseases were ascribed to an acrimony of the fluids, which were supposed to be altered either by a spontaneous change, which caused a predominance of some one of their chemical elements, or by an admixture with foreign substances of an acrid nature. Sylvius de le Boe, Professor at Leyden, the author of this doctrine, was of opinion that there were two species of acrimony, one acid, the other alkaline. His colleague, Boerhaave, designated, in his *Institut.* five species: *viz.* 1. A mechanical acrimony, consisting in the change of the molecules of the fluids, which acquired solid and sharp angles; 2. A saline acrimony, which is muriatic, ammoniacal, acid, alkaline, fixed and volatile, simple and compound; 3. An oily acrimony, produced by a thin oil, as if burned, saline, and acrid; 4. A soapy acrimony, analogous to the animal and vegetable poisons; 5. An acrimony composed of the four preceding, or produced by acrid matters introduced into the body. In his aphorisms, this author reduces the number of species to two, recognizing only the acid and alkaline acrimony. The history of these supposed acrimonies, as a cause of disease, is intimately connected with the exposition of the *humoral pathology;* and it is under that head that it will be most properly considered.

I. H.

ACRINIA. (From α priv. and κρινω, I separate.) A diminution in the quantity, or a suppression of secretion. I. H.

ACRODYNIA. (From ακρον, extremity, and οδυνη, pain.) This extremely indefinite appellation has been employed, by several of the French physicians, to designate a disease which prevailed epidemically in Paris and its suburbs during the years 1828 and 1829, the most striking symptoms of which were intense pains of the wrists and ancles.

History of the Epidemic. The disease was not confined in its attacks to any particular age, to either sex, nor, according to M. Dance, to any particular condition in life; nevertheless, it occurred more frequently in adults and aged persons than in the young, in men than in women, and more commonly among the poor than among those in easy circumstances. It first attracted the attention of the medical men of that city in the month of June, 1828, when it made its appearance among the patients of the hospital Marie Thérèse, of whom thirty-six out of forty were attacked by it. It subsequently prevailed to an equal extent in most of the other hospitals of Paris, and among the inhabitants of many parts of the city. At the same time the disease attacked the soldiers in several of the barracks, as well as the inmates of the prison of Montaigu. In the garrison of the Courtille, out of seven hundred individuals, ninety-seven were affected with the disease. On the third day of September, 1828, it made its appearance

in the barracks of Oursines, attacking five hundred and sixty soldiers out of seven hundred. In a few days, however, the disease abated in violence, and soon ceased entirely. During the winter of this year, the epidemic continued in a mitigated form; but, in the month of March, 1829, it recurred with renewed violence among the garrison of the Courtille, notwithstanding the barracks had undergone a complete repair and thorough cleansing. In four days, two out of every five of the soldiers were attacked. The epidemic gradually abated during the subsequent portion of the year, and, by the middle of the winter, finally ceased. A few cases, however, were observed in 1831 and 1832.

It has been supposed by some, that this epidemic is similar to that which prevailed in different parts of Germany during the sixteenth, seventeenth, and eighteenth centuries, and which is denominated by the writers of that country, kriebelkrankheit. M. Robert, in a memoir which appeared in the *Journal Générale de Médecine*, CV. 15, has attempted to prove its identity with the epidemic known under the name of the *Dengué*.

Symptoms. The invasion of the disease was, in some cases, unpreceded by any premonitory symptoms; in others, it was ushered in by chills, a sense of uneasiness, lassitude, feebleness, more or less acute pain of the limbs, and vomiting. The symptoms that were the most constantly present, and which may, at the same time, be considered pathognomonic of this affection, were lancinating or pricking pains, and a sense of formication in the hands and feet, particularly in the latter, with heat and swelling of those parts. During the presence of these symptoms, the patients were unable to close fully their hands, and when they put their feet to the ground, it appeared to them as though they were treading upon the points of needles or of thorns. The pains always commenced in the wrists and ancles, and were very often confined entirely to these parts. In some instances, however, they extended along the legs and thighs, or the arms, to the trunk of the body, or even to the scalp. The pains varied in intensity. In general, they were more acute at night than during the day.

In many cases, the sensibility of the extremities was so much augmented, that the slightest touch was intolerable; and, at the same time, painful cramps were felt throughout the limbs. At first, a sense of coldness was experienced in the affected parts; but this subsequently changed to one of burning heat, to abate which, the patients were obliged to keep their feet and hands out of bed.

When the patients attempted to walk, it seemed to them, as we have already remarked, as though the ground was strewed with portions of glass, or beset with sharp points. In other cases, a sensation was experienced as though the feet were enveloped in soft cotton, or in down, or as if the ground sunk beneath them at every step. In consequence of the disease of the lower extremities, the walk acquired a very peculiar character, the patient dragging his foot upon its point. When he applied the sole flat to the ground, the toes were bent back, and, of course, elevated.

In the hands, the sense of touch became equally morbid, so that the individuals labouring under this affection could scarcely distinguish any object they laid hold of. To the hands of some, the smoothest and softest bodies felt harsh, and as though their surfaces were covered with minute points. The celebrated Picard, who died of pneumonic inflammation, whilst labouring under this disease, experienced the peculiar sensation referred to, from the contact with his skin of the finest stuffs. Ordinarily, there resulted an inability to flex or fully extend the fingers, and when these motions were attempted to be performed, pain was produced. Hence, it was with the greatest difficulty that the patients dressed or undressed themselves. In extreme cases, all movement of the extremities was rendered impossible. The limbs remained permanently extended upon the bed, and when raised, fell down again like inert bodies.

In the course of the disease, in some cases, contraction, emaciation, or paralysis of the limbs was produced, while, at the same time, very acute deep-seated pains of these parts were felt at irregular intervals, and were augmented momentarily by pressure. To these symptoms were very often added painful cramps of the extremities, and, less frequently, subsultus tendinum.

Either at the commencement, or in the course of the disease, a morbid state of the digestive organs was very generally observed. In some cases, this merely gave rise to loss of appetite, with a sense of fullness and weight at the stomach; while, in others, nausea and vomiting, particularly after eating or drinking, were present. Frequently, the patients were affected with colicky pains, and, more generally, with a profuse diarrhœa, alternating often

with constipation. In some instances, from twenty to thirty stools were passed in a day. Finally, in cases of a more aggravated character, bloody discharges took place both by the mouth and by the anus. Of these affections, the most obstinate was the diarrhœa, which has been known to continue for many weeks, and then to cease for a time, and recur at a later period. In general, however, none of the above symptoms extended beyond the first period of the disease. Occasionally, they were of so trifling a character as to render it doubtful whether they had any immediate connexion with the principal affection.

A redness of the eyes was frequently observed. It was confined either to the conjunctiva lining the eyelids, or to that of the eyeball, and was accompanied with an increased secretion of tears, augmented sensibility to light, and pricking or shooting pains, with a sensation as though sand was interposed between the lids and ball of the eye. It is a curious fact, that, in many cases, these sensations were experienced when not the least increased redness of the eyes was perceptible.

An œdematous swelling occurred ordinarily at the very commencement of the attack. It was most generally confined to the lips, cheeks, feet, and hands, but frequently extended also to the parietes of the abdomen, or even over the whole surface of the body. In the greater number of cases, the swelling was inconsiderable, and unattended with much pain; it retained but momentarily the impression made into it by the finger, and, in a few instances only, produced a change in the colour of the skin. In these, the latter appeared paler than usual, or was covered with ecchymosed spots.

In the course of the complaint, however, the skin underwent various changes. The hands and feet were often of an erythematic redness, from the very onset of the disease. This redness extended in patches over both sides of the hands; but on the feet it began at their external edge, spread gradually towards the sole, and ceased abruptly where the skin commences to cover their upper surface, forming here a kind of red line, or border. Upon the other parts of the body, especially upon the legs, it was in patches of a more or less intense hue, resembling, in many instances, ecchymoses. Very frequently the skin assumed a brown or blackish colour, as if it were covered with dirt. This was particularly the case upon the abdomen, the neck, and in the folds of the articulations. This appearance of the skin was rarely observed upon the face.

The skin was also affected with various kinds of eruptions, either in the form of papulæ, small conical tubercles of a deep red colour, pustules, phlyctænæ, acne, or even furunculi. These eruptions were especially observed around the feet and hands. At the part where the eruptions occurred, a desquamation of the cuticle generally took place, and was renewed several times as the new epidermis was formed. This was particularly the case on the extremities, where likewise copious local perspirations were frequent, recurring often periodically. The cutis was often laid bare in consequence of the entire destruction of the epidermis, causing an intense redness and pain, extending to the surrounding parts. The desquamation, though less marked, occurred also on the other portions of the body: M. Chomel has seen the cuticle entirely detached from the nipple in the form of a little cap. On those parts where desquamation did not take place, a remarkable thickening of the cuticle occurred, particularly about the articulations of the feet. This thickening often caused the formation of a kind of elongated and very painful cushion between the nail and pulp of the finger.

The foregoing symptoms were unattended by any very marked disturbance in the nutrition of the body, or by fever; at least, the amount of febrile excitement was never very considerable excepting in those cases, and at that period of the disease marked by considerable disturbance of the digestive organs.

The patients were, ordinarily, prevented from sleeping by the pains and other uneasy sensations from which they suffered: in some cases the patients have been known to be kept awake for twenty nights in succession.

The above are the principal symptoms by which the disease was accompanied; they, however, varied considerably in different cases. In some, the morbid sensibility of the extremities was the most prominent phenomenon; in others, it was the disordered condition of the digestive organs; in others, again, the œdematous swellings of the surface, the brown or blackish hue of the skin, or the eruptions by which the latter was covered, were the most striking symptoms.

Difference of locality appeared to have some influence in the production of certain symptoms, or at least in rendering these more predominant than others. Thus, in the prison of Montaigu, almost all the patients

presented the brown hue of the skin, while this symptom was not observed in any of the soldiers belonging to the barracks of Oursine or Courtille. In the former, the prominent symptoms were numbness of the limbs, œdema of the face, ophthalmia, and vomiting; in the latter, contractions of the limbs. Again, in the Hospital La Charité, neither subsultus tendinum nor cramps were observed, while in La Pitié a number of patients were affected with both.

Acrodynia has been divided by some writers into several stages, according to the order and succession in which the different symptoms present themselves. The first stage, according to them, is that characterized by derangement of the digestive organs, œdema of the face and hands, erythematic redness of the latter, and inflammation of the eyes. In the second stage we have numbness of the extremities with desquamation of the cuticle, a brown hue of the skin, and eruptions on the surface of the body. The third stage is marked by the gradual decline of all the symptoms. But the march of the disease was far from being regular,—in some cases the first stage was absent, or, rather, the symptoms occurred in a different order. Neither were all the symptoms invariably present in every case. The disease was equally irregular in regard to its duration; being prolonged, in some instances, for several months, while in others it ceased after a few weeks. In general, however, it lasted for a considerable time. In many cases the disease abated or was apparently removed for several days, when it again occurred, and the patients continued to suffer from it so long as the epidemic lasted.

Although in general an obstinate disease, acrodynia seldom terminated fatally. Only a few old persons, and individuals labouring under chronic affections of the viscera, died of it. The Hospital Marie-Therèse, the inmates of which are all aged persons, is the only public institution where a number of deaths occurred: here eighteen persons sunk under the disease.

Causes. Much difference of opinion exists as to the causes by which the epidemic was produced. According to one party, the disease occurred principally among such of the soldiers as were lodged in the most humid and worst ventilated apartments of the several barracks, and among the poor who inhabited narrow and damp streets, and dwellings excluded from the air and sun. It is also stated, that during the prevalence of the epidemic bread was very dear at Paris, and hence the poor, who live in a great measure upon it, were obliged to purchase that of an inferior quality, which was baked expressly for their use. The same kind of bread, it is likewise asserted, was used in the barracks. (*Journal des Progrès des Sciences Médicales*, 1828.) On the other hand, it is maintained by M. Dance and others, that the epidemic cannot be attributed to aliment of a bad quality, for, if this was the case, they ask, why did not the disease prevail equally among the soldiers in all the barracks, they being all nourished alike? At the Hospital Marie-Therèse, notwithstanding the bakers and other persons who supplied the food consumed in that institution were changed, new cases of the disease still continued to occur, while the epidemic did not affect those in the immediate vicinity who ate food procured from the same persons who supplied the hospital.

In regard to the supposed production of the disease by an atmosphere rendered impure, either by defect of ventilation, by too many persons being crowded together within a narrow and confined space, or by the decomposition of animal or vegetable filth, M. Dance conceives that this could not have been the case, inasmuch as a number of the inhabitants of Paris were attacked who resided in detached houses, the air of which was in all respects sufficiently pure. The epidemic likewise prevailed in some of the most healthy of the barracks, as well in regard to their location as to their internal arrangements and police, while it did not occur in others less advantageously circumstanced; those especially in the streets du Foin and Mouffelard, whose situation is altogether unhealthy, while their chambers open only upon a narrow confined court. The apartments also the best ventilated were often those in which the greatest number of cases of the disease occurred—this was particularly the case in the barrack of the Courtille. (*Dict. de Méd.* Art. *Acrodynie.*)

By some, the disease has been supposed to be produced and propagated by contagion; the facts adduced in proof of this opinion are, however, so few and inconclusive as to demand no particular attention.

Pathology. Equally various have been the opinions advanced as to the immediate cause of the peculiar symptoms by which this disease was characterized. On this question we can receive no light from pathological anatomy. In consequence of the few who died during the epidemic, and the rareness, hence, of autopsical examinations, we are almost entirely igno-

rant of the changes in the condition of the internal tissues connected with the disease. The lesions that have been observed, are set down by the gentlemen who made the examinations, as the result of a morbid condition of the organs, unconnected with the peculiar affection of which we are treating.

By some writers, acrodynia is considered to be a species of rheumatic disease; others refer it to a concomitant inflammation of the mucous membranes and skin; others, again, believe it to consist in an inflammation or irritation of the spinal marrow. This last opinion would appear to account most readily for the morbid condition of the sensibility, motility, and, in many cases, the nutrition of those parts in which the external symptoms principally manifested themselves. It is nevertheless true, that in the few post-mortem examinations that have been made, the spinal marrow was not found diseased, excepting in an instance or two where a paraplegia was evidently mistaken for the disease of which we are treating. Others have considered it to depend upon an inflammation seated in the cellular membrane, and M. Recamier has suggested whether it may not be a variety of scurvy. Finally, the dependence of acrodynia upon inflammation of the arteries or veins has been very plausibly maintained.

A parallel has been drawn between the present epidemic and various others that have been presumed to depend upon a vitiated state of the grain employed for the preparation of bread in certain districts. Many of the latter were, in fact, accompanied by most of the symptoms which characterize acrodynia; as for example, the formication, numbness of the feet and hands, amounting, in many cases, to paralysis; contraction of the fingers, cramps of the legs, swellings of the feet, and the appearance upon the latter of phlyctænæ. This was particularly the case in the epidemic which prevailed in Hesse in 1594, in relation to which a report was published by the medical society of Magdebourg. A similar epidemic occurred two centuries subsequently in England and in many parts of Germany, and was described, among others, by Waldschmied and Scheffel in 1717, and by Muller in 1742. A similar epidemic likewise prevailed in Béthune and Lille in 1749, of which Boucher has left us an admirable account.

Treatment. The different views entertained in relation to the pathology of acrodynia, gave rise to a great variety in the modes of treatment pursued by different physicians. By some, the disease was treated by bleeding, bathing, local or general, frictions and blisters, and by the administration internally of the compound powder of ipecacuanha. By others, opium, assafœtida, valerian, and the sulphate of quinine, were the remedies chiefly employed. Purgatives and emetics were prescribed by others. Another class of practitioners depended on the treatment pursued at La Charité in colica pictonum; this, in the hands of M. Cayol, appears to have been attended with considerable success: while they who considered the disease to depend on inflammation of the spinal marrow, directed cups, blisters and moxa to the spine, and strychnine, &c. internally. Sulphurous baths and fumigations were employed by many, while M. Recamier believes that he has seen much benefit result from the administration of the juice of sorrel.

The treatment, however, from which the greatest amount of benefit appears to have been derived in the generality of cases, was bleeding general and topical, general and local bathing, emollients to the affected parts, sometimes rendered narcotic; in other cases, rubefacients, or astringent applications or blisters, in conjunction with a proper diet and regimen. When this treatment was persevered in for a sufficient length of time, it seems almost always to have produced an amelioration, at least, in the more prominent symptoms of the disease.

Bleeding from the arm, according to M. Dance, was useful only in plethoric subjects, or in cases of accidental congestion. *Leeches* to the edges of the feet were found to reduce the erythema, but to have no effect upon the sense of numbness in the extremities; applied over the abdomen, they had little effect in relieving the gastro-intestinal affection; along the spine, however, to many practitioners, they appeared to produce an amelioration of all the symptoms. *Bathing*, either in simple hot water or in vapour, as well as sulphurous and aromatic baths, were not found, according to M. Dance, to produce in general much effect upon the disease—in many cases none whatever. *Emollient cataplasms* to the feet were seldom beneficial in quieting the formication in those parts, frequently they increased it. From *frictions* with a liniment containing either turpentine or ammonia, greater advantage was derived; the same is true also of *cold washes* to these parts, or a lotion composed of a solution of *acetate of*

lead. Frictions with *turpentine* are said to have been very beneficial in many of the epidemics supposed to be produced by the use of damaged grain, particularly that described by BOUCHER.

Of all the external remedies employed, *blistering* appears to have been the most effectual in removing the numbness and in calming the formication of the extremities, particularly in those cases in which the pains were not confined to the latter. Applied to the limbs, but especially along the spine, blisters caused frequently a very speedy cessation of the symptoms alluded to. The *moxa* was employed in a very few instances only, and without any decided benefit. *Opium*, internally exhibited, produced a temporary abatement of the pains and the other uneasy sensations from which the patients suffered; but no permanent good was derived from its use. It was principally in cases in which the disease exhibited an intermittent or remittent form, that the *sulphate of quinine* was resorted to; its use appears, however, to have been unattended with any decided advantage.

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D. F. CONDIE.

ACROMINIAL, relating to the acromion. I. H.

ACROMION. The process which terminates the spine of the scapula, and is articulated with the external extremity of the clavicle. (See *Bones.*) I. H.

ACTÆA. Baneberry.

Sex. syst. Polyandria monogynia. *Nat. Ord.* Ranunculaceæ.

Gen. Ch. Cal. 4-leaved, deciduous. *Pet.* 4, often wanting. *Style* none; stigma capitate. *Berry* superior, 1-celled, many-seeded. *Seeds* semi-orbicular. *Recep.* unilateral. NUTTALL.

The genus *Actæa*, as established by LINNÆUS, contained many plants which differed materially in their essential characters. PURSH therefore removed the *A. racemosa* to CIMICIFUGA, another LINNÆAN genus; in this he has been followed by many modern botanists, and by the editors of the U. S. Pharmacopœia, and U. S. Dispensatory, from which circumstance we shall consider the *A. racemosa* under the head of *Cimicifuga*, (q. v.) although this plant, does not agree with the generic characters of *Cimicifuga* better than with those of *Actæa*, as will be hereafter pointed out.

The genus under consideration contains several species that are possessed of active qualities, though their use as therapeutic agents appears to be very limited.

A. spicata. Baneberry. *Herbe de St. Christophe*, Fr.; *Achrentragendes Schwarzkraut.* Germ.

Sp. Ch. Berries roundish. *Petals* length of the stamens. *Raceme* ovate. *Leaves* 2–3 ternate. LINDLEY.

This plant is found in many parts of Europe in mountainous woods. The root is a violent purgative, somewhat analogous in its effects to the black hellebore. The berries are poisonous, as is indicated by the common name of the plant. LINNÆUS states (*Flor. Lappon*) that their ingestion causes violent delirium, and even death; this observation of the Swedish naturalist is confirmed by M. LEMERCIER, of Rochefort, who found that they, as well the plant generally, produced a species of intoxication, followed by much disturbance of the cerebral functions, and an irritation of the digestive organs. (*Merat et Delens.*) These effects, however, appear to depend on a volatile principle which is dissipated in a short time, for the dried plant has been administered in large doses without any ill consequences resulting. The principal medical use of this species is as an external application in itch. A decoction of it is said to destroy lice with as much certainty as the stavesacre.

A. americana. White and red cohosh.

Sp. Ch. Berries ovate, oblong. *Petals* shorter than the stamens. *Raceme* ovate. *Leaves* biternate. LINDLEY.

Under this head we include both the

alba and *rubra*, although it is more than probable that they are distinct species. But as many botanists recognize them as varieties only, and as their physical qualities are identical, no confusion can arise from thus uniting them This species was confounded by LINNÆUS, SCHOEPF, &c. with the *A. spicata*, to which it is very closely allied, both in appearance and qualities; the berries, and probably the whole plant, possessing the deleterious properties of the foreign plant. It is, however, seldom or never made use of except in mistake for the *Cimicifuga*; the full grown roots bearing some resemblance to those of the last named plant. Many writers have, however, confounded them together, and have spoken of the *Actæa* as identical in its medical effects with the black snake root. MERAT and DE LENS have materially added to this confusion in attempting to correct the error. Thus they ascribe all the virtues of the latter to the former, and state that they are indiscriminately used by American physicians. This is far from being the case, and, as is observed by Dr. TULLY, it is perhaps owing to the adulteration of the *Cimicifuga* with *Actæa*, that the expected good effects of the former have not been obtained.

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R. E. GRIFFITH.

ACTION. (From *agere*, to act.) The exertion of power. All matter is in a state of activity. Incessantly subjected to the influence of various forces, it is constantly undergoing changes. The processes by which these changes are effected, are termed *actions*, and from these actions result all the phenomena of nature. As there are various forces, so also are there several species of actions, thus—1st. Actions take place between the molecules of bodies, producing changes of composition: these result from a force termed *affinity*, and the actions which it produces are named *chemical*; such are the action of acids upon alkalies, &c. 2d. Actions result from impulsion, from the motion impressed upon matter in masses; this is the effect of a force to which the epithet attraction has been given, and which acts at greater or less distances; examples of this are furnished by gravity, the magnet, electricity, &c. 3d. Certain actions take place only in organized bodies: these depend upon the inherent vital properties of the organs, and they are termed *vital* actions. When these actions are normal, of a healthy character, they are termed physiological; when abnormal, diseased, *pathological*. Certain vital actions are termed functions; and by some writers the two terms have been very improperly confounded. (See *Function.*)

Organic action is employed by some physiologists as synonymous with tonicity; it has also been employed to express the actions between the molecules of organized matter, under the influence of vital force, or vitality.

In *therapeutics*, the term action is employed in a double sense: first, to designate the active force of all therapeutic agents; and in this sense we speak of the medicinal action in general, or the special action of a remedy on a certain organ: secondly, it is employed to indicate the primary or secondary effects of a medicinal article, as we speak of a tonic action, a sedative action, &c., taking the effect for the process by which it is produced.

It is, of course, impossible to enter into the investigation of all these actions, as such an inquiry would embrace the consideration of every phenomenon of nature. The whole science of medicine is a history of the vital actions. I. H.

ACTIVE. Having the power to communicate action or motion; that which acts with energy. It is in the latter sense that it is employed in medicine. Thus every medicine is, strictly speaking, active, since, did it not act, it could not be a remedy; but the epithet is bestowed on such as are prompt and energetic in their effects.

In physiology, it has been applied to those organs of locomotion which produce motion by their action, as the muscles. An active sensation is one in which the sense is directed to the object. Active life, of BUISSON, is the animal life of BICHAT.

In pathology, it has been applied to diseases in which there is an increased action in the affected part, and is here synonymous with *sthenic*, (q. v.) I. H.

ACTUAL CAUTERY. (See *Cautery.*)

ACUPUNCTURE. (From *acus*, a needle, and *punctura*, puncture.) The operation, consisting in the introduction of a needle-shaped instrument into various parts of the body, intended to act as a remedy.

Historical Sketch. This operation, practised from time immemorial in China and

Japan, was not known in Europe until towards the end of the seventeenth century, when Ten Rhyne, a surgeon in the Dutch East India Company's service, gave an account of it in a Latin work published in London in 1683. Subsequently, in 1712, Kœmpfer, in the third Fasciculus of his *Amœnitates Exoticæ*, noticed the same operation, and added some details to those published by Ten Rhyne. Deriving their information from this double source, Dujardin, in his "*Histoire de la Chirurgie*," mentioned the remedy in 1774, and, in 1787, Vicq-d'Azyr, published an account of it in the "*Enclyclopédie Methodique*." The latter author characterizes it as an irritant and stimulant remedy, which may be useful in overcoming spasms and restoring sensibility to organs in which this function has become weakened. Nevertheless, these two authors do not recommend acupuncture; and no practical results are to be found on record until 1810, when Dr. Berlioz first tried it in a case of painful nervous disease, occurring in a young female, as recorded in his work on *Chronic Diseases*, &c., published in 1816. In the same work, he mentions several additional cases, in which he found the remedy useful. It appears, however, that the physicians of that period were not disposed to imitate the practice of Dr. Berlioz, but, on the contrary, attributed to it the character of temerity. Beclard, indeed, rejects the operation as useless, and sometimes dangerous. The next physician who appears to have given much attention to acupuncture, was Dr. Haime, of Tours, who was led to use it from having met with the cases of Dr. Berlioz. Dr. Haime's results were published in 1819, in the *Journ. Univer.*, and confirmed and extended in a paper by Demours, published in the 66th vol. of the *Journ. Général de Médecine.* About the same time, Dr. Bretonneau, chief surgeon to the hospital of Tours, began to employ the remedy, and made a number of experiments on inferior animals to determine its safety. Churchill, an English surgeon, appears to have been the next writer of any importance on this operation, and was the second person, (Mr. Scott, of Westminster, being the first,) who performed it in England. His results, together with a short account of the mode of performing the operation, will be found in a small treatise published by him in 1821. Notwithstanding these repeated testimonies in favour of the efficacy and safety of acupuncture, no extensive series of experiments was made with it until 1825, when the subject was taken up anew and prosecuted with great ardour by M. Jules Cloquet, in the Hospital Saint Louis, which furnished an extensive field for experiment. His results were made known to the public by his pupils, M. Morand and M. Dantu; and, from their diversified character, and the reputation of the physician under whose observation they were obtained, the operation immediately gained the confidence of a large portion of the medical world, and has been practised, with more or less success, by a considerable number of observers in France, Germany, England, and the United States.

Considering the source from which we derive the operation, and the absurd claims set up by its inventors for its possessing the power of curing almost all diseases, it is not surprising that civilized nations should have viewed it with distrust, if not with contempt. In Japan, the whole practice of medicine appears to consist in the use of acupuncture and moxa, employed according to certain rules, which the practitioner is not allowed to depart from. The points at which the operations are to be performed, appropriate for each morbid affection, are indicated by dots and lines on puppets, called *Tsoe-bosi*, made of pasteboard, and about two feet high. For a plate of one of these puppets, as well as for a treatise on acupuncture and moxa, as practised by the Japanese, the curious reader is referred to Sarlandiere's work on Electro-puncture. The operation is performed in the East usually by means of a hammer, by which the needle is cautiously driven into the part. One set of men, called *Tentassi*, indicate the places where the needles are to be inserted; while another set, denominated *Foritatte*, perform the operation. The needles employed are about four inches long and very slender, and are said to be always fabricated of gold or silver. The operation is resorted to in the most opposite diseases; and the operators do not hesitate to penetrate important cavities and viscera, such as the stomach, intestines, uterus, &c.

Form of the Instrument, its mode of Employment, &c. Acupuncture, since its adoption as a remedy by scientific physicians, is not employed precisely as it is in the East. By them it is performed with a slender steel needle, of various lengths, from half an inch to five or six inches, sharp, straight, well polished, and furnished with a convenient handle of hard wood or ivory, about as thick as a quill. The needle should be

well tempered, to avoid the risk of its breaking in the tissues. The handle is sometimes permanently attached; but a more convenient construction is to have it separate, and furnished with a steel socket, to receive the end of the needle, which may be fixed securely, after being inserted, by the pressure of a small lateral screw. The instrument which we have found most convenient, is represented in the accompanying figure of half the natural size. The figure requires no explanation, except to point out the lateral screw, the handle of which is seen at *a*. By this construction, the operator can at pleasure fix in the handle a needle of such length as may be suited to the depth to which he proposes to penetrate, and after inserting it, is enabled to detach the handle by relaxing the screw.

Eight or ten needles, of various lengths, may be all fitted to the same handle, by having them finished with cylindrical buts, three-sixteenths of an inch long, and about as thick as a knitting-needle. These buts, being of larger dimensions than the shaft of the needle itself, effectually prevent the instrument from burying itself in the tissues, when allowed to remain after the detachment of the handle; an accident which has happened many times under the notice of Berlioz and Dantu, but without being attended with any ill consequence. The needles and handle are usually fixed in a small morocco case, for their more convenient preservation, the former being passed through some soft substance to preserve their points. Another arrangement is to have the needle furnished with a permanent ivory handle, to the lower part of which an ivory sheath screws, inclosing the needle when not in use; but this plan is more expensive and less convenient than the other. Where acupuncture needles, expressly made for the operation, are not at hand, their place is easily supplied by well-tempered sewing needles; their ends being covered by a small olive-shaped ball of sealing wax, to serve as a handle.

The spot for the operation being determined on, and the needle being selected of the desired length, and secured in the handle, the operator first stretches the skin at the spot by the fore and middle finger of the left hand, and then applies the point of the instrument, supported by the thumb and fingers of the right hand. Next, by a rotation, performed alternately in opposite directions, and by a gentle pressure, the needle is made to penetrate to the intended depth. As the operation proceeds, moments will occur when the patient will experience more pain than at others; and the operator may find it necessary to stop the operation, until this goes off. Indeed, it will be best, in all cases, to pause from time to time, during the insertion of the needle, for the purpose of inquiring of the patient what modifications in the condition of the part have been experienced by him. Occasionally, as the needle is penetrating, it will meet with greater resistance than at first, and afterwards pass with greater quickness, just as if it had been first resisted, and then suddenly passed through some membrane. Having penetrated to the desired depth, the handle is detached, and the needle allowed to remain, for various periods, from 10 minutes to 24 or even 60 hours, according to the views of the operator. The Japanese have a uniform rule of letting the instrument remain while the patient makes thirty inspirations, and no longer. M. Cloquet has insisted on the importance, in some cases, of letting the needle remain for a long time; and, accordingly, he has, in some instances, allowed an interval of five or six days to elapse before its extraction. For the remedy, used in this way, he proposes the name of *persistent acupuncture*. As a general rule, the more chronic the disease combated, the greater will be the length of time necessary for the needle to remain in the tissues. In most cases, several needles (from two to four or five, or more,) are inserted in quick succession on the same occasion; though, sometimes, a single one is sufficient to remove the pain or other affection for which the remedy is resorted to. Some operators are in the habit of pressing the needle into the flesh without rotation; but this is not an eligible plan, as it gives more pain, and causes the needle to wound the animal fibres rather than to pass between them, as it is supposed to do, when rotation is used. The pain caused by the operation is very variable. Sometimes it is nearly nothing; at other times, more or less severe; but, as a general rule, the amount of it is so inconsiderable as to be totally disregarded by the patient. When, in the progress of the operation, the pain becomes suddenly severe, it may be generally made to cease, either by withdrawing the needle a little, or else by passing it forward for half an inch or more. By pur-

suing either course, the point is removed from the tissue, its presence in which may be supposed to have caused the pain. In a few instances, CLOQUET has observed a sudden pain to dart from the point of the needle like a shock of electricity; and the writer of this article has once observed the same phenomenon. No inference can be drawn from the occurrence or absence of pain, as to the relief the operation is likely to afford. When the needle has been inserted into a muscle, its end is often observed to oscillate, in consequence of the point being carried to and fro by the contraction of the muscle. In a great majority of cases, an areola appears around the needle, after an interval varying from a few minutes to half an hour. A slight numbness is often felt by the patient; while some remark a sensation of heat, and others of cold, in the vicinity of the needle. Fainting occasionally takes place, but this too is rare; not occurring, according to the estimate of CLOQUET, oftener than once in thirty times. The writer has in one case observed a disposition to faint; but in no instance complete syncope; though the extent of his experience embraces more than fifty cases.

The needle may be withdrawn by means of a pair of forceps, or by the aid of the re-attached handle. The fingers are often sufficient for this purpose, in case the needle has not been inserted very deep, and a sufficient portion of it remains outside, to allow of its being securely seized. In taking out the needle, it is best to press upon the skin on each side of it by two fingers; otherwise the skin will adhere to the needle, and be painfully drawn out in a conical form in the act of extracting it. The removal of the instrument is almost always more painful than its insertion; and the pain is generally in proportion to the length of time it may have remained in the tissues. These circumstances are explained by the oxidation of the needles, which renders them rough, and the more so the longer they may have remained. Upon the insertion and extraction of the needle, no blood, as a general rule, appears; but, occasionally, upon its extraction, a small drop or two is found to follow. The needle, whenever made of an oxidizable metal, is uniformly the seat of a galvanic current, recognizable by the galvanic multiplier of SCHWEIGGER, as shown by MM. PELLETAN, Jun., and POUILLET. The remedial effects of the operation, however, do not depend upon the establishment of this current; for these effects are equally produced when gold and platinum needles are used, in which no oxidation, and consequently no galvanic current occurs. As soon as the needle is withdrawn, it should be immediately polished by passing it repeatedly through an emery bag, or by rubbing it with emery paper, before being put away; and the same should be done to insure its perfect smoothness just before any needle is used.

Therapeutical Applications, &c. Numerous experiments, made on the inferior animals since the revival of acupuncture, have shown that the operation is devoid of all danger. BECLARD, BRETONNEAU, CLOQUET, VELPEAU, DANTU, MEYRANX, and others, have shown that the puncture of arteries, nerves, and even of the principal viscera, by very fine needles, is scarcely ever followed by any serious effect. BECLARD's experiments were confined to the puncture of the arteries; but those of BRETONNEAU extended to the penetration of the stomach, brain, lungs, and heart. The latter experimenter frequently passed needles through the brains of puppies in various directions, without, in some instances, producing pain, and uniformly without causing any accident or apparent inconvenience. He afterwards passed them into the heart of five puppies, and three received no injury. Finally, M. BRETONNEAU became so confident as not to hesitate to introduce the point of a very fine needle into the brachial and radial arteries in his own person. Similar experiments on the inferior animals were made by VELPEAU and CLOQUET, who confirm the observations of BRETONNEAU. From these results, it is natural to infer that acupuncture might be employed in the human subject, without reserve, in any part. Nevertheless, the best writers on the operation advise the avoidance of the large arterial and nervous trunks, and of the more important viscera and joints. There can be no doubt, however, that the stomach and lungs have been occasionally penetrated in the human subject without the least inconvenience; but we do not recommend an imitation of the practice; and no one would think of puncturing the brain, unless to evacuate serum in extreme cases of hydrocephalus.

The safety and limits of the operation being thus established, it remains merely to give an outline of its therapeutical applications. And here it will be found that our knowledge is still very imperfect; as the experience which we as yet possess is not sufficient to enable us to lay down principles in the application of the remedy. So far as it has extended, it has shown

that acupuncture is applicable to the cure or relief of various painful affections, when not attended with active inflammation, or dependent on organic disease. Accordingly it has been found useful in muscular rheumatism; chronic pains, not attended by heat, or obvious inflammation; neuralgia in its various forms; sciatica; lumbago; hemicrania; strained state of the muscles from lifting heavy weights; deep-seated contusions; hiccup; cramps; uterine pains; ophthalmia, &c. It has been resorted to with occasional benefit in paralysis; but has proved unsuccessful in the trials made with it in tetanus, chorea, aphonia, deafness, &c. It has been proposed by Dr. Carraro as a means of exciting the contractions of the heart in asphyxia from drowning, and would probably be a justifiable expedient, after ordinary means had failed. He supports his proposition by the results of his experiments on kittens, which, after having been drowned until every appearance of life was extinct, were resuscitated by acupuncturing the heart. His experiments, however, have been repeated by Dr. E. J. Coxe, of Philadelphia, and were not found to succeed. (*N. Amer. Med. and Surg. Journ.* II. 292.) We must infer, therefore, that there is some peculiarity in the mode of proceeding of Dr. Carraro, which requires explanation before his results can become practically useful.

In rheumatism, the success of acupuncture has probably been greater than in any other affection. Of 129 rheumatic cases, treated by this remedy, in the practice of Cloquet, 85 were cured. Dr. Elliotson cured 30 out of 42 cases, by the same means, in St. Thomas's hospital. The writer has had a number of similar cases, and the great majority yielded to acupuncture. In neuralgia the remedy is much less successful; and some cases, reported as cures of this disease, were probably other affections of a painful character. The late Dr. J. H. Ewing, of Philadelphia, reported one successful case of neuralgia of the face. (*N. Amer. Med. and Surg. Journ.* II. 77.) The writer has tried it several times in this disease, and has known it to be tried by several of his friends, but without any encouraging success. Numerous cases of its advantage in sciatica are on record, among which may be quoted the cases of Dr. Renton, (*Ed. Med. and Surg. Journ. for* 1830, XXXIV., 100,) and those of Dr. Graves, in the Meath Hospital, Dublin, (*London Med. Gaz. July*, 1831, and *Lond. Med. and Surg. Journ. April*, 1833.) Recamier and Cloquet have reported several cases of shooting uterine pains relieved by the needles, inserted obliquely into the parietes of the vagina. (Morand, *Memoire sur l'Acupuncture.*) In cases of ophthalmia, the remedy can be viewed only as a means of lessening the severe pains which so often attend this disease; and by no means as a substitute for the remedies ordinarily employed for combating the inflammation. In these cases, the needles are inserted into the temple, or forehead, as near as convenient to the affected eye. On the same principle of relieving pain, Dr. Renton found it useful in one case of hip-joint disease. The cases of benefit from acupuncture in paralysis are few. M. Trouvé, physician in chief to the hospital of Caen, reports a complete cure of the disease, of seven years' standing, resulting from a fall on the back; and a case of relief by the needles, of paralysis of the upper extremities, caused by taking cold while the patient was suffering under salivation, is recorded as occurring, under the care of Dr. Macbraire, in the London hospital. (*Lond. Med. Gaz.* 1831, VII. 607.)

As connected with the therapeutical applications of acupuncture, may be mentioned the proposal of Velpeau to apply it to the purpose of curing aneurism. Repeating, in 1822, some experiments on dogs, consisting in puncturing the arteries, which he had seen performed in 1818 by his preceptor Bretonneau, he found, in several instances, that the wounded vessel became the seat of a coagulum, and was finally obliterated. The experiments were repeated and extended in 1830, in December of which year, Velpeau read a paper before the Academy of Sciences of Paris, proposing acupuncture as a means of obliterating the arteries in aneurism. In all cases in which the needle remained three days, the transfixed artery was found completely obliterated. Supposing that the same results would ensue in the human subject, it would follow that those aneurisms which are now cured by cutting down to the artery above the dilatation, and tying it, might be treated with equal success, without cutting the skin, by merely transfixing the vessel in the same situation with a fine needle.

Acupuncture may be advantageously performed on the legs in anasarca, for the purpose of evacuating the serum, instead of punctures with a lancet, which are objectionable, from giving rise occasionally to sloughing. It may be resorted to with benefit also in many cases of œdema, as,

for example, of the scrotum and penis, and is never attended with the least inconvenience as a consequence of the punctures. (Dr. Elliotson.) Dr. Horner, of Philadelphia, resorted to acupuncture, with success, for the purpose of evacuating the serum in a case of congenital hydrocephalus. (*Amer. Journ. of Med. Sci.*, IV. 530.) Dr. Finch has proposed acupuncture as a means of ascertaining the nature of tumors, and the depth at which collections of fluids may be situated.

In performing acupuncture, the general rule is to insert the needle into the painful or affected part; but if the nature of the part forbids this, then at the nearest safe point. The only exception to this rule is furnished by cases of neuralgia, in which, according to Cloquet, a neighbouring part to the one affected is most proper for the operation. According to the same authority, it is best merely to reach the painful part with the point of the needle, and not to pass it.

The modus operandi of acupuncture, as a remedy, is unknown. The relief it affords, in some cases, is surprisingly prompt; so much so, indeed, as sometimes to impress the vulgar mind with the idea of supernatural agency. In many instances, however, the operation produces only partial benefit; and requires to be repeated a number of times before a complete cure is effected. The Japanese suppose that the puncture lets out some hurtful flatus, to the confinement of which in the organs, they attribute all diseases. Among scientific inquirers, some suppose it to act merely by revulsion, others by stimulating the nerves and restoring to them a principle of which they have been deprived by pain. Dr. Haime, and Cloquet also, hold the more probable opinion that nervous pains depend upon an inordinate accumulation of the nervous fluid in particular parts, and that acupuncture relieves by equalizing the distribution of this fluid. The writer adopts this opinion as the most probable; and will merely throw out the conjecture, that in many cases of local pain this accumulation of the nervous (electrical?) fluid depends upon the altered state of the various fasciæ, or condensed sheets of tissue, giving them the power, to a certain extent, of insulating the parts which they serve to embrace. On such a supposition, the presence of a metallic conductor, transfixing the several insulated parts, would effectually equalize the distribution of the fluid.

Acupuncture in connexion with Electricity and Galvanism. As connected with acupuncture, it is proper to mention, in this place, *Electro-puncture* and *Galvano-puncture.* By these terms are meant acupuncture as modified by employing the needle as a conductor for the passage of an electrical or galvanic current to or from the tissues. The idea of electro-puncture originated with Berlioz; but the operation itself was first put in practice by Sarlandiere, who published a memoir on the subject at Paris in 1825. The operation consists in performing acupuncture with a needle in the usual way, and then making it communicate with the conductor of an electrical machine. Sarlandiere considers acupuncture, thus modified, to be possessed of additional valuable powers, and speaks of his success with it in the treatment of rheumatism, paralysis, gout, and many nervous affections. The superiority, however, of electro-puncture over acupuncture is not well established; and more facts are still wanting to determine upon the value of Sarlandiere's views.

M. Magendie has recently read a note to the Academy of Sciences of Paris on galvano-puncture as a remedy in amaurosis. Reflecting on the remarkable influence which the fifth pair of nerves exerts on the sight, he commenced his experiments, on animals, by acupuncturing the fascial branches of this nerve. No accident happening, he extended his experiments to man. A needle was passed into the frontal nerve, at the point where it emerges from the superciliary foramen; and the patient experienced, over the whole of the corresponding side of the head, a sensation similar to that which is experienced when the nerve of the elbow is struck, and was enabled to indicate with precision all the subdivisions of the nerve on the superior part of the cranium. Subsequently the frontal nerve was punctured within the orbit, and finally the lachrymal nerve itself, with the effect of causing a very abundant flow of tears. The pupil was found to contract whenever any branch of the fifth pair was pricked; but no benefit was experienced to the amaurosis, for the relief of which the trials were made. M. Magendie now employed galvanism in connexion with the needles. He fixed a needle in the frontal nerve, and another in the superior maxillary, and these were made to communicate severally with the poles of a galvanic pile of twelve pairs of plates, each six inches square. Every time the contacts were established, the patient experienced a painful commotion in the course of the nerves and at the bottom of

the orbit, the light became more sensible, and the pupil contracted. M. MAGENDIE reported several cases of incomplete amaurosis, with or without paralysis of the muscles of the eye, in which galvano-puncture furnished very satisfactory results. M. LEROY D'ETIOLLES has proposed galvano-puncture as a means of reducing strangulated hernia, by inducing a powerful and sudden contraction in the loop of intestine as it exists in the sac; and he supports his recommendation by the favourable results of numerous experiments on inferior animals.

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ACUTE. (*Path.*) This epithet is applied to those diseases which are of a severe character and have a rapid progress and short duration. See *Disease.* Pain is said to be acute when it is sharp and pungent. I. H.

ACYANOBLEPSIA. (From α priv. κυανος blue, and βλεπω I see.) Defect of vision, consisting in the incapacity to distinguish blue. I. H.

ACYSIS. (From α priv. and κυειν to conceive.) Sterility. (q. v.) I. H.

ADDEPHAGIA. (From αδδην much, and φαγειν, to eat.) Voracity. See *Bulimia.* I. H.

ADDITAMENTUM. An addition to any part, which though not always, is sometimes found. It was formerly used synonymously with *Epyphisis* (q. v.); but is now applied only to the prolongations of the lambdoidal and squamous sutures. I. H.

ADDUCTION. (From *ad* to, and *ducere* to draw.) The action by which parts are drawn towards the axis of the body. I. H.

ADDUCTOR. This epithet is bestowed upon several muscles which perform the office of adduction. See *Muscles.* I. H.

ADENALGIA. (From αδην, gland, and αλγεω, I suffer.) Pain in a gland. I. H.

ADENEMPHRAXIA. (From αδην, a gland, and εμφρασσω, I obstruct.) Engorgement of glands. I. H.

ADENIFORM. (From αδην, a gland, and *forma*, form.) Of a glandular form.

ADENITIS. (From αδην, a gland.) Inflammation of glands. I. H.

ADENOGRAPHY. (From αδην, a gland, and γϱαφω, I describe.) A description of glands. I. H.

ADENOIDES. (From αδην, a gland, and ειδος, like.) Resembling a gland. I. H.

ADENOLOGY. (From αδην, a gland, and λογος, description.) A treatise on the glands. I. H.

ADENO-MENINGEAL. (From αδην, a gland, and μηνιγξ, a membrane.) PINEL designated by this ephithet the epidemic which prevailed at Goëttingen in 1760, and which was described by RŒDERER and WAGLER, (*Tractatus de morbo mucoso*,) because the seat of that fever was in the intestinal mucous membrane, and principally in the muciparous glands. It is the *Dothinenteritis* (q. v.) of BRETONNEAU. I. H.

ADENO-MESENTERITIS. (From αδην, a gland, μεσος, midst, and εντερον, intestine.) Inflammation of the lymphatic glands of the mesentery. Tabies mesenterica. I. H.

ADENO-NERVOUS. (From αδην, a gland, and νευρον, a nerve.) PINEL has applied this epithet to the plague, the principal seat of which he places in the nerves and in the lymphatic glands of the arm-pit and groin. I. H.

ADENO-PHARYNGITIS. (From αδην, a gland, and φαρυγξ, the pharynx.) Inflammation of the tonsils and pharynx. I. H.

ADENOPHTHALMIA. (From ασην, a gland, and οφθαλμος, the eye.) Inflammation of the glands of meibomius. See *Lippitudo*. I. H.

ADENO-SCLEROSIS. (From αδην, a gland, and σκληρος, hard.) SWEDIAUR has given this name to tumefactions and indurations of the glands, unaccompanied with pain, and which do not become scirrhus or cancerous. I. H.

ADENOTOMY. (From αδην, a gland, and τεμνω, I cut.) The art of dissecting glands. I. H.

ADEPS. See *Fat*.

ADHESION, *Adhesive*. (From *adhærere*, to stick to.) According to the commonly received acceptation of the term among morbid anatomists, adhesion may be defined to be a preternatural continuity of tissue established between surfaces originally contiguous, but disconnected. With surgeons, when used in its narrowest sense, it signifies the re-establishment of the continuity of parts separated by accidental injuries, when this union is effected without the secretion of pus, or the formation of granulations. If all the morbid phenomena which result from the same cause were associated under the one general head of adhesion, it would be necessary to give much greater extension to its signification; but, in the present article, the word will be employed agreeably to the definition just given. For a further knowledge of the operations of the law upon which the production of adhesions depends, the reader is referred to the several heads under which the pathology of the different tissues and cavities is considered, and also to the general articles *cicatrix*, *inflammation*, *stricture*, *suppuration*, and *wounds*.

Adhesions may take place either before or after birth, and, in the former case, may perhaps result from an original defect of organization: such appears to be the case in the congenital imperforate condition of the nose, mouth, anus, vagina, eye-lids, &c.; but these vices of structure will be considered more properly in the articles on malformation and monstrosity. The intention of nature in accomplishing adhesion, even in parts originally designed to continue separate, is always sanatory; and it is only when the process is arrested before its completion, or when the functions of the organs interested experience a mechanical embarrassment, that it becomes a source of disease: an adhesion of the peritoneum which prevents effusion from an ulcerated intestine, is as decidedly healthful in its tendency as that which produces the immediate union of an incised wound. It is, therefore, rather for convenience than from a strict sense of philosophical propriety, that we follow CRUVEILHIER in dividing adhesions into two classes, the *restorative* and the *morbid*. This author appears to have been actuated by the same motive, for he says, (*Dict. de Méd. et Chir. Prat.* art. *Adhesion*,) that adhesion does not constitute a disease, properly so called; it is but an effect, a termination of inflammation, and sometimes results from causes so occult as not to admit of explanation; often it prevents or remedies serious accidents, and sometimes it is provoked by art in order to accomplish important purposes, becoming, in the hands of the surgeon, a powerful therapeutic engine.

The mechanism by which adhesion is effected is the same in all cases, and the bond of union is not altered in character by the nature of the tissues which it unites. It is, therefore, decidedly advisable to study first the phenomena attendant upon the process as displayed in injuries of external parts, where everything is subject to immediate inspection, and afterwards to consider the proofs of the identity between

this restorative operation, and the coalescence of distinct organs in situations less capable of direct examination.

1. *Restorative Adhesions, or those which take place between surfaces originally continuous.*—All parts of the body, when divided by mechanical means, exhibit a tendency to adhesion, but the union can only be completed under certain favourable circumstances, the most important of which is the juxtaposition of the divided surfaces. The presence of a foreign body must necessarily impair the firmness of the new connexions, until it is removed either by the surgeon or by the absorbents; and the process is equally checked or arrested, by too great a degree of general or local debility, whether caused directly, by the violence of the accident, or consecutively, by excessive inflammation. This tendency to adhesion between accidental surfaces, is nevertheless so strong that it is extremely difficult to prevent it, when such an object becomes desirable in the treatment of surgical diseases. Hence it requires great care to effect the establishment of fistulous canals, or substitutes for obliterated passages; as in wounds of the duct of Steno, strictures of the urethra, &c.; hence, also, the frequent failure of attempts to reclose such canals when once completely formed, and converted into a part of the surface of the body by the complete organization of a cuticle or mucous membrane.

Let us now consider the phenomena of adhesion as exhibited in one of the simplest possible cases, that of an incised wound. Upon the first occurrence of the accident, the face of the wound is bathed in blood, much of which escapes or is washed away by the surgeon, but a part generally remains. The wound is carefully closed, and in a very short time a certain degree of cohesion between its edges is distinctly noticed. This occurs much sooner when blood is present, and it is then obviously due to the coagulation and mechanical action of that fluid, as it takes place even when foreign bodies are present. Sometimes neither pain, redness, nor swelling, exists in the neighbourhood of the injury, but the bond of union goes on constantly acquiring firmness, and after the lapse of a few days, the part is found in its original condition, with the exception of a linear cicatrix marking the direction of the incision. In such cases there may exist no visible marks of irritation or inflammation, nor do we always observe the elaboration of any peculiar fluid between the edges: if the first dressings are agglutinated to the wound, it appears to be only by coagulated blood. This is what Mr. Hunter considered the first or most simple form of adhesion, and he taught that the effused blood was the sole bond of union; that its colouring matter being absorbed, it was converted into coagulated lymph, and became permanently organized, by its own innate vitality. That coagulated blood may remain for a long period as a firm bond of union between divided parts, and that it often exists to a considerable amount in deep wounds, without apparently interfering with the progress of what has been termed union by the first intention, are facts too frequently observed to be denied by any surgeon. But it is equally certain that these coagula often remain in contact with the most delicate tissues, even for years, without producing irritation, continuing firmly adherent without becoming organized. Moreover, very large collections of coagulated blood are frequently absorbed, and the cavities which they occupy are obliterated without the formation of pus or induration, by a process which cannot be proved to differ from that of union by the first intention, except, perhaps, in its slower progress. It follows, therefore, that blood does not become organized with facility, even under highly favourable circumstances: e. g., in effusions into the serous cavities: nor is it by any means certain that its presence interferes with those measures by which nature accomplishes adhesion when no blood is suffered to remain between the divided surfaces, which measures will be presently examined. We incline, therefore, to the opinion of Thompson, who regards extravasated blood as a foreign substance, which must be removed either by the surgeon, or by the absorbents, before union can be effected.

The blood is nevertheless in many cases an important auxiliary agent in favouring adhesion by its mechanical action; it is the mildest of all possible dressings, and beneath it, the vital operations go on without embarrassment. It coagulates with great facility when brought into contact with surfaces in a state of inflammation, and gives rise to many phenomena hereafter to be noticed. (See *Artery*, *Vein*, *Gangrene*, &c.)

In cases of wounds in which no blood remains between the surfaces, it was formerly thought that union was occasionally effected by direct inosculation, without the interposition of any organic medium; but the doctrine of union strictly immediate, is now abandoned. The usual order of the

phenomena which attend upon simple adhesion in an incised wound is as follows. At the moment of the accident there is a sensation of pain, which varies in different parts, according to the nature of the tissue divided. This is immediately succeeded in most, if not in all cases, by a heightening of the vital energies in the part, and an afflux of fluids, constituting what was termed by Hunter, adhesive inflammation, and what is now understood by those of the physiological school as irritation. Very soon after this, the edges and surfaces of the wound are covered by an exudation of plastic matter, which fills up all inequalities and serves to unite the parts. It is this matter, at first fluid, but shortly acquiring consistence, which agglutinates the dressings a few hours after their first application, and renders their removal painful or difficult. In twenty-four hours, or even sooner in many cases, this effused matter assumes the form of a membrane, not organized, it is true, but sufficiently firm to be separable in the form of a distinct layer. In less than forty-eight hours it gives evidence of vascularity, for when torn by a forcible separation of the edges, blood flows freely from the ruptured vessels. In a few days it is completely organized, and finally it becomes fibrous, and so firm that it has been doubted whether it does not possess more strength than the original structure. It is hardly possible to determine by actual observation, the manner in which the organization of this new matter is effected in incised wounds, but the facts collected from the examination of the same process on a larger scale, will be given hereafter. (See *Pseudo-Membrane*.

Coexistent with the formation of the new membrane, we generally perceive an increased redness, more or less tumefaction, and, in the first instance, pain in the immediate neighbourhood of the wound; but it cannot be denied that considerable injuries of this nature, sometimes recover without the obvious presence of any of these symptoms. This latter fact leads naturally to the question, whether adhesion is necessarily the effect of inflammation. It is somewhat singular that Mr. Hunter, many of whose followers are in the affirmative, was himself decidedly in the negative on this point. In his work on the blood, p. 168, 8vo. edit., he says, "Inosculation, however, can only take place where the extent of the parts divided is not great, and the opposite surfaces remain near each other; but even then, it is most probable that we must in part ascribe to another mode of union, the communication of vessels which takes place between the two divided surfaces; for where inosculation does not, or cannot take place, the union of the ruptured vessels is produced by the coagulation of the extravasated blood of this part, which becomes vascular." Again, at p. 180: "When the former bond of union is lost in a part, to produce a new one, a secondary operation takes place, namely, inflammation; and if this is likewise lost, then a third mode of union will arise, which is by means of granulation." He was too accurate an observer not to have noticed that union, even when unattended by inflammation, was effected through the medium of a new layer of coagulable lymph; but he believed that in this case the layer was furnished by the vital action of the extravasated blood, and the activity of the absorbents which removed the colouring matter and the superfluous parts of the coagulation. But when adhesive inflammation took place, he thought that similar lymph was thrown out from the closed vessels, by a process analagous to secretion.

Few pathologists continue to consider the effused blood as a bond of union in wounds, except perhaps in fractures, (q. v.), but there are two conflicting opinions still prevalent as to the origin of the coagulable lymph forming the new membranous medium of adhesion. John Bell appears to think that it is simply effused from the cut surface, without any peculiar elaboration, (*Discourses on Wounds*, part I. p. 11.), and he discards, unhesitatingly, the term adhesive inflammation, as inapplicable to a process which he regards as purely physiological. (Ibid. p. 23.) M. Maunoir considers the adhesion of extensive lacerations and flaps, which sometimes takes place without any mark of fever or inflammation, as a proof that the bond of union is not the result of any unusual action in the part, but that it is effected by the coagulation and gradual hardening of the circulating juices, (*Mémoire sur les Amputations*, p. 51.); and M. Serre, subscribes to the same opinion. "It is a phenomenon," says he, "of the same order with that which unites the ovum to the uterus." (*Traité de la réunion immédiate*, p. 44.) Dr. Thompson, MM. Cruveilhier, Breschet, &c., on the contrary, believe that a peculiar secretory operation is necessary to the formation of the new bond, and incline to the opinion that inflammatory action is necessary to the performance of this operation. "If the effusion of coagulated lymph," says the first author quoted, "ever

does take place from the vessels actually divided, it would seem to depend on a change in the action of these vessels, by which they are in some measure converted from circulating into secreting organs." (*Lectures on Inflammation*, p. 169.) One of the least objectionable views of this important subject of discussion is that adopted by MM. Roche and Sanson. "Like the flow of blood, this exudation of the white fluids is owing to the division of the vessels of the tissues and of the tissues themselves; when the opposing surfaces are placed in contact, this lymph is necessarily spread in a layer between the lips of the lesion. Driven out from its natural conduits and placed beyond the domain of vitality, it speedily coagulates. But the part is presently attacked by *irritation*, or rather, already painful and irritated by the effect of the accident, its irritation increases rapidly, its vitality is augmented, and the layer of coagulated lymph promptly assumes the character of a membrane." (*Nouveaux élémens de pathologie*, II. 504.)

It is contrary to the law of simplicity observed in all the works of nature, to suppose that the bond of union is a simple exudation in one set of cases, and a regular secretion in another, or to attribute it to the vivification of blood in some instances, and to a peculiar result of inflammation in others. The occasional recovery of extensive wounds without the obvious presence of increased heat, swelling, or redness, and with no pain except that which results from the direct effect of the accident, appears to us a sufficient proof that inflammation is not necessary to the production of adhesions: it seems also to establish the fact, that the natural powers of the system are adequate to the purpose, without the necessity of any remarkable exaltation of power; and that even when such an exaltation is observed, the effusion of the coagulable lymph often precedes, instead of following the development of the irritation, the heightened action being designed, not for the formation, but for the vivification of the bond of union. It has been remarked by M. Serre, that there may be some change in the powers of the divided vessels by which they may be enabled to elaborate a fluid somewhat different from the lymph of circulation, without the occurrence of inflammation. This idea, though possibly correct, is hypothetical. In the present state of our knowledge, we have no conclusive evidence to show that adhesion requires any change in the natural functions of the wounded part, or that the lymph of the circulation differs essentially from the lymph of a false membrane before it becomes organized.

If the manner in which the bond of union in injuries is effected, continues still a matter of dispute, the views of physiologists as to the mode in which the new product becomes organized is not more firmly settled. It is well known that at the moment of division the divided vessels are retracted by virtue of their elasticity, and that they are speedily closed by the effused coagulable lymph. The question of the simple elongation of the extremities of the vessels, is no longer in doubt; and it is almost universally acknowledged that if the divided extremities ever become continuous, as they certainly appear to do, after simple incisions for the relief of Pterygia, (q. v.) it is through the medium of a new portion added to the vascular tube by the organization of the new intermediate membrane, and not by the elongation of the original vessels, as was formerly supposed.

That secondary inosculation does take place by some means, is sufficiently proved by the direct experiments of Duhammel on six chickens, in which he divided by successive incisions all parts of an extremity, without respecting any tissue, not excluding the osseous, and in one instance at least, without incurring the loss of the limb: it is equally proved by the success of the trials at grafting the parts of one animal upon the body of another, as narrated by Hunter, as well as by many of the Taliacotian operations. All further discussion of the mode by which the circulation is re-established between divided surfaces, must be referred to the articles on several surgical subjects where the phenomena due to the law of adhesion are exhibited on a grander scale—and more especially to that on the reproduction of Bone.

Whatever may be the character of the tissues involved, however dissimilar the nature of the opposing surfaces, the process of union is accomplished by the same measures. The new bond is precisely similar in all cases. In the skin, muscles, cellular tissue, glands, &c., union is everywhere effected by the effusion of coagulable lymph, its organization and conversion into fibrous matter. In no instance does the tissue interested primarily reproduce itself, and if the continuity of tissue is ever completely re-established, it is only after the lapse of a considerable period of time. (See *Cicatrix*.) Most authors have considered the reunion of the osseous tis-

sue as an exception to this law; the propriety of this exception will be investigated in the proper place. (See *Bone, reproduction of.*)

As like effects everywhere result from like causes, we must seek for the explanation of the uniformity of the process of restoratory adhesion in all the various tissues, by tracing the existence of some agent common to them all. The only agent of this universal character, is the cellular membrane. The matrix of every organ;—capable of a vitality apparently independent in the lower orders of apathic animals, and composing the whole fabric of our own species in the earliest stages of fœtal life, there can be no doubt that this membrane, in which the organs are originally formed, is also the active agent of their reunion and reproduction, if the latter indeed takes place, a fact of which we entertain no question, notwithstanding there is high authority against it. (See Cruveilhier, op. cit.)

Restoratory adhesion, when it occurs in injuries which have no communication with the surface, and cannot be relieved from the presence of any portion of the effused blood or other fluids, takes place less rapidly; but in the absence of the air, which facilitates the decomposition of the fluids and thus becomes a cause of inflammation, it takes place more certainly. The process is precisely similar to that already described; and this class of accidents was even selected by Hunter in preference to incised wounds, as furnishing the simplest exemplification of adhesion.

2. *Morbid Adhesions, or those which take place between contiguous surfaces, but which were originally designed to remain separate.* Besides the morbid adhesions noticed in the serous and synovial cavities, the mucous and vascular canals, and between the different parts of the cutis vera when denuded of its cuticle, there are others equally comprised within the limits of our definition, which are seated in the cellular tissue. Commencing with the latter, we will cast a rapid glance at each of these in turn.

a. Morbid Adhesions of the cellular tissue. Whenever the cellular tissue becomes the seat of an irritation somewhat severe and continued, there is an evident tendency to adhesion around the affected spot. The first morbid effect noticed is the deposition within its cells, of a yellowish serum and of coagulable lymph, by which the plates of the tissue are agglutinated together and their permeability destroyed. A temporary barrier is thus generally formed against the progress of inflammation, which would otherwise spread itself unchecked over an extensive surface, as it is observed to do when this barrier is not fully completed, in consequence of peculiar states of the constitution: witness the progress of erysipelas phlegmonoides, and the diffuse inflammation of the cellular tissue, of Duncan. When resolution takes place the deposited lymph is gradually absorbed, and the part either returns to its original condition, or remains indurated by the coalescence of the parietes of the cells, which unite in the same manner with the edges of an incised wound, constituting a proper case of primary reunion. M. Cruveilhier believes that every inflammation of cellular tissue results in this species of permanent induration—hence, in tumours of the neck of which the roots involve the cellular membrane enveloping the principal blood-vessels, he considers extirpation impossible if the tumour has ever been inflamed; for in such cases the adhesions render elaborate dissection necessary, where under other circumstances simple enucleation is all that can be required. We cannot agree with this opinion in its whole extent, for it is evident that in many cases, the condensed membrane ultimately recovers its original condition, either by the absorption of the coagulated lymph, before it becomes organized, or by a veritable transformation of the new matter into free cellular tissue, of both which changes we have seen ample evidence. (See *Cicatrix.*) These adhesions are nevertheless exceedingly embarrassing to the surgeon, and cannot be neglected with impunity in forming a judgment on the practicability of an operation. In these indurations the adipose vesicles disappear, and are not again detected until after a long period has elapsed.

It is on the same principle; that of the adhesion of the proximate surfaces of the cellular tissue by means of effused coagulable lymph, becoming organized and forming a new membrane; that those sero-mucous cysts are established which we occasionally see in parts subjected to frequent pressure, as beneath the skin of the elbow and instep, on the tuberosity of the tibia, &c., (See *Bursa-mucosa.*) and also those which sometimes remain after the absorption of extensive ecchymoses, those which surround an abscess, a foreign body, a hydatid, &c. (See *Cyst.*) To the like cause we must attribute the formation of fistulæ of every kind. (q. v.) In all these affections there exists a lining membrane more

or less analogous to the cuticle in structure, and formed in the same manner with the bond of union in an incised wound.

b. Adhesions of the Serous Membranes. These are of very frequent occurrence, and take place on a grander scale than in any other situations. The process by which they are produced is the same in all the cavities, nor does it differ from that already described under the head of restoratory adhesions; but in consequence of the great amount of new matter sometimes thrown out, we are enabled to become better acquainted with some of the steps in the progress of organization in the coagulable lymph of false membranes in the thorax and abdomen, than in those produced by the lesions of the cellular tissue.

The strong tendency of all irritations of serous surfaces to become general throughout the cavity, is known to every one; their equally remarkable tendency to adhesion is the counteracting course by which nature controls this unfortunate disposition. The slightest possible injury is frequently sufficient to cause the coalescence, or rather the agglutination, of the proximate serous surfaces. Thus the pressure of a cyst or tumour in the abdominal parietes, or the presence of a foreign body in the stomach or intestines, is often sufficient to induce the adhesion of the neighbouring peritoneum, so that the cavity of that membrane frequently escapes the danger of effusion when an ulceration has caused a fistulous connexion between an abdominal viscus and the cavity of a superficial abscess, or the surface of the body. So trivial indeed are the causes which sometimes lead to these new connexions, that it is not unusual to find extensive adhesions after death in patients who have never been conscious of disease in the part during life. "In fine," says M. Serre, "if we admit the possibility of adhesion by simple exudation, it must follow that the presence of pseudo-membranes cannot be a positive proof of the existence of a phlogosis. This opinion, though very paradoxical, casts doubt upon a problem which has been considered as solved: we submit it to the examination of the profession. Contenting ourselves with noticing the fact, we leave the explanation to others." (*Sur la Réunion Immédiate*, p. 49.)

Upon the first occurrence of an irritation, the coagulable lymph begins to collect upon the opposite surfaces of the serous membrane, precisely as it does between the lips of an incised wound. It is firmer where it lies in contact with the original structure, and in the centre it remains for some time almost fluid. This change of density is in certain cases gradual and uniform, at other times it takes place at intervals, giving the new product a lamellated appearance. M. Cruveilhier considers the central portions as secreted last, and conveyed by percolation through the spongy structure of the previous layers. Beneath this new deposit the original surface of the serous tissue remains apparently unaltered. We waive all question, in this place, as to the peculiar mode in which this new bond of union becomes organized. This highly interesting question would necessarily lead us into disquisitions upon many subjects which could not be conveniently arranged under the present head. (See *Pseudo-Membrane*.) That it passes through the same changes noticed in the reunion of incised wounds, is obvious, and it is equally certain that it finally takes on all the characters of proper cellular membrane.

These adhesions, though generally somewhat extensive in the commencement, become frequently elongated by the motion of the organs which they connect, and they then present the appearance of a tissue with large areolæ, of partial septa, or of filamentous attachments, large at the extremities, and more or less attenuated in the middle. This elongation is of course greater in proportion to the time which has elapsed from the first formation of the adhesion; it is effected sometimes by the yielding of the new bond itself, and sometimes by an infundibular depression of the original serous membrane to which it is attached, caused by the constant dragging of the parts during their necessary movements.

It is asserted that adipose matter is never found in accidental membranes, and although we have met with two cases and have heard of a third, in which this matter was apparently present in old adhesions of the pleura, the cases were not examined with sufficient care to warrant us in asserting that it was not located in a situation external to the serous membrane, in the infundibular depressions just noticed.

Adhesion occurs much more frequently in some of the serous cavities than in others. The pleura presents the greatest number of instances, the peritoneum stands next in order, then the pericardium, the tunica vaginalis testis, and finally the arachnoid membrane, in which adhesions are very rare.

Adhesion is frequently employed as a means of cure in cases of accidental cysts, and in dropsy of the tunica vaginalis testis.

The method of treatment consists in the evacuation of the cavity, the production of sufficient irritation, and the coaptation of the opposite surfaces by mechanical means if necessary. (See *Hydrocele.*)

c. Adhesions of the Synovial Surfaces. The articular synovial tissues very rarely adhere, and their adhesions have been still more rarely observed with accuracy; but both the flocculent false membrane and the organized and cellular connexion have been met with in cases of anchylosis. (q. v.) The vesicular synovial sacks of tendons often become obliterated by adhesion, and the same result happens to their vaginal sheaths, in panaris, diseases of the joints, deep burns, &c. To this cause is due the retraction of the flexor tendons of the hand which sometimes results from long-continued repose. We have seen several singular instances of this kind among the devotees of Hindostan.

d. Adhesions of the internal surfaces of vessels. The lining membrane of the arteries adheres with great facility. This is proved not only by the manner in which these vessels become obliterated after wounds, or the application of ligatures, but also by the history of many diseases in which no other tissue can be a party to the process. Such, for instance, as the dry gangrene, in which the principal arteries are all obliterated for some distance beyond the limits of the dead matter. This obliteration may be either a cause or a consequence of the mortification; for it is a law of nature that whenever the blood ceases to circulate through a vessel it soon becomes obliterated. One of the most beautiful proofs of adhesion of the internal surface of the arteries from this cause is furnished by the operation for the cure of aneurism by pressure between the tumour and the heart.

The veins are more prone to suppuration than to primary adhesion, but the latter occurs, in many instances, after mechanical injuries, venesection, the excision of varices, &c. M. Cruveilhier has even seen filamentous adhesion in the iliac veins. There is scarcely a blood-vessel in the body which has not been found obliterated in examinations post-mortem; but for details upon this subject the reader is referred to the articles on *Aneurism*, *Artery*, *Vein*, and *Ligature*.

The lymphatics are generally so small that their adhesions have escaped observation, though analogy would lead us to infer that they are not less frequent than those of other vessels. Professor Nasse once found the thoracic duct completely obliterated and converted into a cord, though the valves were still distinguishable; and Sir A. Cooper narrates three cases of partial closure of the same canal. M. Breschet, however, denies that there is on record a single incontrovertible case of the obliteration of a lymphatic vessel. (*Dict. de Méd.* art. *Adherence.*) The partial obstruction of the arterial circulation in a part may induce gangrene, and that of the veins occasions œdema.

e. Adhesions of mucous surfaces.—The mucous membranes, in common with the external integuments, are protected against the danger of adhesion in many parts by a proper cuticle, and where this fails, its place is supplied by a mucous effusion equally inorganic, therefore acting like a foreign body interposed between the lips of a wound. When this protecting envelope is destroyed, or changed in character by accident or disease, the cellular tissue which forms the base of the membrane acts as the same tissue is known to do under like circumstances in other places, and the bar to the formation of adhesion is removed. The same new membrane observed in injuries of other parts, is very frequently seen on all the mucous surfaces. Delpech demonstrated its existence wherever pus is secreted, (see *Cicatrix*,) and Cruveilhier considers it a common consequence of acute mucous inflammation. But in order that it should produce adhesion, it is indispensable that two different portions of mucous surface should be placed nearly in contact, while both are deprived of their mucosity; and these requisites are very rarely fulfilled. Inflammation may, indeed, influence the nature of the secretion, so that it no longer fulfils its proper functions, and then we see the surfaces coalesce. Bichat was certainly wrong when he supposed that a loss of substance was always necessary to the formation of adhesions in mucous canals. The vagina has been repeatedly found obliterated after inflammation. Cruveilhier mentions a patient of Dupuytren in which this effect followed a laceration of the recto-vaginal septum in parturition. The occlusion of the os uteri, and the obliteration of the fallopian tubes in tubular pregnancy, and in girls of ill fame, as remarked by Walter, Meckel, and Breschet, are cases equally in point. The ureter is sometimes closed above or below an arrested calculus. The gall duct, in many instances, and sometimes the gall bladder itself, have been found destroyed by adhesion. Cases of this kind may be found in the works of nearly all the pathological anatomists. Those passages which are covered by a cuticle or

epithelium are, of course, protected against adhesion until that membrane is removed by accident or disease. "It is certain," says Breschet, "that the venereal virus seems to give to the mucous membranes a peculiar disposition to contract adhesions." (*Op. Cit.*) It is generally about the orifices of mucous canals, where the epidermis still exists, that the inflammation centres in venereal cases, and every surgeon knows how liable to excoriation parts thus affected become. When denuded of their epidermis, the mucous secretion is here deficient; hence the greater frequency of adhesion remarked by Breschet.

Enough has been said to show that the mucous tissue is subject to the same general law which governs the restoratory process in other parts; but it is not the less true that adhesion takes place with great difficulty in such situations; and the instances in which it occurs without loss of substance are comparatively rare. In the intestinal canal they are extremely so: it is remarkable that, in artificial anus, the intestine below the injury may contract, but never becomes closed.

f. Adhesions of the cuticular surfaces. The skin is never placed in juxtaposition to itself in such a manner as to contract adhesions, until after the destruction of a portion of its cuticle; it is then placed in the same circumstances with the divided cellular tissue in wounds, and may unite with any part which is retained in contact with it. The terrible deformities resulting from burns are examples of the unhappy effects of the law, and the beautiful operations performed within a few years for the restoration of lost features, show how useful it may be rendered by the surgeon.

Adhesion of suppurating and ulcerated surfaces. See *Cicatrix.*

Adhesions of the osseous tissue. See *Bone, reproduction of.*

Adhesion, as a cause of disease. See *the articles on the several cavities and organs.*

Adhesion, as a therapeutic remedy. See *Hernia, Hydrocele, Operations Rhinoplastic, &c.*

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See, also, the Bibliography of the several articles to which reference has been made.

Reynell Coates.

ADHESIVE INFLAMMATION. See Arts. *Adhesion* and *Inflammation.*

ADHESIVE PLASTER. See *Plaster.*

ADIANTUM. Maiden hair. *Capillaire*, Fr.; *Frauenhaar*, Germ.

Sex. Syst. Cryptogamia Filices. *Nat. Ord.* Filices.

Gen. Char. *Sori* oblong or roundish. *Indusia* membranaceous, arising from the margin of the frond and opening upwards. Nuttall.

Most, if not all, the species of this genus of ferns, are possessed of the same properties; there are only two, however, which are recognized in the Pharmacopœias. These are so identical in their medicinal effects as to be used indiscriminately. They are slightly aromatic and agreeable to the taste. The active qualities appear to reside in its mucilage, and the weak astringent principle with which this is united. They are used in infusion in mild catarrhal affections, but their principal employment is in the celebrated *Syrop de Capillaire*, one of the most popular pectoral remedies among the French. This syrup, which is a pleasant summer drink, like all other demulcent and mildly expectorant remedies, is useful in slight catarrhs, and has the advantage of not offending the stomach even when taken in large quantities. It is made by infusing four ounces of the leaves in six pints of boiling water, straining the fluid, dissolving in it four pounds of refined sugar, boiling to a syrup, and adding a small quantity of orange-flower water.

A. capillus veneris. Maiden hair. *Capillaire de Montpellier*, Fr.; *Venushaar*, Germ. *Sp. Char.* "Frond bipinnate, pinnules obovate-cuneate, inciso-sublobate, segments of the fertile pinnules terminated by a linear-oblong sorus, sterile ones serrated." Hooker. This species is found in many parts of Europe, growing in moist situations, on rocks, or by the sides of rivulets.

A. pedatum. Rock fern. American maiden hair. *Capillaire du Canada*, Fr. *Sp. Char.* "Frond pedate, branches pinnate; pinnæ dimidiate oblong-lunate, upper margin incised; sterile segments dentate; fertile ones entire; sori linear; stipe glabrous." Willdenow. This species is exceedingly common in the northern and

middle states; occurring in rich soil on hills and among rocks. At one time large quantities were exported to Europe from Canada; but of late years little has been sent. It is rather more bitter and aromatic than the European.

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ADIAPHROSIS. (From α priv., δια, through, and φορος, a pore.) Suppression of perspiration. I. H.

ADIARRHÆA. (From α priv. and διαρρειν, to flow.) Retention of any excretion. I. H.

ADIPOCIRE. (From *adeps*, fat, and *cera*, wax.) A substance of a yellowish or dirty white colour, which is formed by the change that the soft parts of an animal body undergoes when exposed for a certain length of time to the action of moisture, and at the same time protected from the effects of the air. It was first discovered in removing the bodies from the burial ground of the *Innocents* at Paris, in 1787, and received the above name from Fourcroy, who, however, classed with it several other animal substances, which more recent researches have shown to be distinct. *Adipocire* is composed of margaric and oleic acids, united with a colouring matter, and a little potash, lime, and ammonia. As this substance is of no utility in medicine, any further notice of it would be superfluous.

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ADIPOSE. (From *adeps*, fat.) Fatty.

ADIPOSE TISSUE, (*Tela Adiposa*,) thus designated, in consequence of its fatty character, or the adeps it contains, is a structure which is widely diffused throughout the organism, and is formed of an assemblage of minute rounded particles or vesicles of a light colour, closely agglomerated together, which are embedded in the interstices of the common cellular or filamentous tissue.

Art. I. Adipose Tissue, *Anatomy of.*—The adipose tissue exists under two forms, which, though similar in their fundamental characters, are, nevertheless, sufficiently distinct in some of their properties to entitle them to a separate consideration. The first is the *general Adipose Tissue*, or that which occupies the superficies of the body and the surface and interstices of the organs; the second the *medullary Adipose Tissue*, or *marrow*, disposed within the cavities of the bones.

§ 1. *The General Adipose Tissue.*—The fatty matter which constitutes the proper base of the adipose tissue may be said, in general terms, to exist in almost every portion of the organism, but in different degrees, and under different forms; being, in most of them, in a free state, but in some, in an intimate state of combination with the structures which it occupies. We shall confine our observations principally to that form of the tissue which is in a free state, and which is manifest to the senses without any previous chemical preparation.

The quantity of the adipose tissue is so exceedingly variable in different individuals, that no very accurate estimate can be made of the relation it bears to the whole mass of the organization. It has been supposed, however, that in a well-formed adult subject of ordinary stoutness and *embonpoint*, it constitutes about one-twentieth part of the entire volume of the body. But in those who are lean and emaciated, its quantity is considerably diminished, and, in many cases of protracted diseases, it so far disappears as to be scarcely manifest in any situation. In some instances, on the other hand, its relative proportion is much greater than has been represented; and sometimes, indeed, it becomes so inordinately developed, as to preponderate, both in volume and weight, over the entire mass of all the other structures of the body. In cases of obesity, it is frequently accumulated in such quantity that the specific gravity of the body becomes even less than that of water. In an Italian priest of the name of Paola Moccia, it was so inordinately developed that he weighed two hundred pounds, and had a specific gravity less, by thirty pounds, than that of water, upon the surface of which he floated like a cork. (*E. H. Weber in Hildebrandts Handbuch der Anatomie.* Band I. p. 244. Braimschweig, 1830.)

The adipose tissue, though extensively diffused, is not perfectly continuous throughout its whole extent. It forms in most situations a thick stratum between the skin and subjacent muscles, and generally has its quantity very much increased at those points which have to sustain considerable pressure, or are submitted to much motion; as, for the example, the buttocks, where it forms a soft cushion upon which the indi-

vidual may repose with ease, in the palms of the hands, the soles of the feet, and in the vicinity of the large articulations. A thin stratum exists beneath the scalp, with which, and the pericranium, it adheres very intimately. It is also abundant about the face, and in the interstices of the lobules of the parotid gland. In the cheeks it forms large rounded masses, which contribute to their fullness and symmetry, and the bottom of the orbit is occupied by a considerable mass, upon which the ball of the eye reposes and moves with freedom. On the anterior part of the neck it is more abundant than on the posterior; but it exists sparingly between the skin and the platysma myoides muscle: on the median line of the neck it is for the most part wanting. About the mammæ, especially in the female, and beneath the pectoral muscles, it exists in great abundance; and upon the anterior and lateral parts of the abdomen it is more abundant, in corpulent persons, than in any other situation on the superficies of the body. It also penetrates the interstices of the voluntary muscles; and in those which are composed of large fasciculi, as the gluteus, it forms a considerable portion of their mass. It also exists in the interstices of the fasciculi of some of the larger nerves, and between those of the ligaments, and forms considerable masses of a fimbriated arrangement in the duplicatures of the bursæ and synovial capsules.

Turning our attention next to the interior of the body, we shall find a small quantity of adipose tissue situated within the cavity of the spinal column, between the dura mater and the bone. In the cavity of the thorax, it occupies the superficies of the heart, the anterior and posterior mediastinum, and the intercostal spaces. But the abdomen, of all the splanchnic cavities, contains the largest portion of adipose tissue. It forms large masses around the kidneys, within the numerous duplicatures of the peritoneum, as the omentum, mesentery, and epiploic appendages, and exists in considerable abundance within the lateral and inferior portions of the pelvis.

But however diversely disposed, its arrangement is everywhere directed by infinite wisdom. Thus, in some situations, it contributes to perfect the symmetry and beauty; in others, we find it facilitating locomotion, constituting a means of protection, and filling up the void spaces between the several organs: under the same wise provision of nature, we find it wanting where its presence is not required, or where its inordinate accumulation might curb or embarrass the motions of the organs, or interfere with the regular exercise of their functions. Thus, it does not exist upon the choncha of the ear, within the cavity of the cranium, in the eyelids or the nose. Neither is it found in the sheaths of the vessels, in the submucous cellular tissue, the lymphatic glands, the scrotum, penis, testicles, nymphæ, vagina, or uterus. It exists sparingly in the kidneys, but in the liver and spleen it is not found in a free state.

The adipose tissue cannot be observed during the four first months of the fœtal existence, but makes its appearance about the fifth month. It first becomes manifest immediately beneath the skin, in form of small isolated grains or particles, which continue to multiply, and finally become clustered into extensive masses, which occupy nearly the whole superficies of the body. It is still, however, confined for the most part to this situation, and imparts that plumpness and rotundity for which children are so remarkable. It is only at a later period that it makes its appearance in the splanchnic cavities and upon the surface of the organs, but as age advances it becomes abundant in these situations, and frequently acquires such a degree of development as to preponderate considerably over that which occupies the superficies of the body. There are, however, several circumstances, besides the influence of age, which have a tendency to increase or diminish its quantity. Thus, it is more abundant in the female than in the male; its quantity is augmented by high living and indolence, especially if to these causes be added perfect tranquillity of mind, and an avoidance of excessive venereal indulgence. The influence of the latter cause is strongly manifested by the great tendency there is to obesity at that period of life at which the venereal desires become blunted or extinct, and by the rapidity with which domestic animals grow fat after the operation of castration, or the destruction of the functions of the testicles by any cause whatever. There seems, moreover, to be a strong disposition to the development of the adipose tissue in those organs, the functions of which have become impaired or suspended, or which are atrophied from old age or any other cause. In many cases, indeed, such a quantity of fat is generated, under these circumstances, that it seems to supplant the proper structures of the organ. We frequently find the muscles and even the heart of old persons almost transformed into a mass of adeps; the

kidney, when atrophied, sometimes has its place supplied by the same substance; and even the scrotum, in which we have seen the adipose tissue does not exist in the natural state, becomes filled up with it where the testicle has been removed by an operation or destroyed by atrophy. (*Jannssen, Abhandlungen von Thierischen Fette.* Halle, 1786, p. 76.) According to HULSENBUSCH, (*Dissertatio de Pinguidine*, 1728, p. 18,) it is also sometimes found within the cavity of the uterus of some animals; and it has been observed that the extirpation of the ovaria produces the same tendency to its developement in the female that castration does in the male.

The form and density of the adipose tissue are variable in different portions of the system, according to the properties of the cellular tissue in which it is deposited. In the orbits of the eye, the cheeks, the axillary regions, and upon the symphisis pubis, it is soft and lax in its arrangement, and consists of considerable rounded masses. In most other parts of the body these masses are smaller, and are composed of minute clustered particles of fat, separated by their cellular tissue; but in the scalp, and in the palms of the hands and the soles of the feet, the investing cellular tissue is strong, compact, and fibrous. Within the cavity of the abdomen, on the contrary, it consists of considerable pyriform, or pedicellated masses, disposed upon the surface of the peritonæum and within its duplicatures.

In all cases, the adipose tissue is softer and more delicate in proportion as the subject is younger, and becomes more solid as age advances. There has been some difference of opinion relative to the question whether the fat exists in the fluid or the solid state in the living animal. In man and the carnivorous animals, it was long since observed by SANCTORIUS and others that it is fluid. HALLER also states that he has often observed a white pellucid fluid oil, or fat, in the omentum, heart, ovaria, and extremities of living dogs and other warm-blooded animals, (*Elementa Physiologiæ*, 4to, I. 28.) In many of the fish, and especially in animals of the whale tribe, a large quantity of fat exists in a perfectly fluid state within the cavity of the cranium. In the ruminating animals, however, it appears to be much more consistent than in man, and although it is sometimes found in the fluid state, as already represented, several circumstances, such for instance as its being unable to infiltrate the cellular tissue, seem to show that it must be somewhat solid even in the human subject, or at least that it possesses much more consistence than many other fluids.

1. *Organization of the Adipose Tissue.* The adipose tissue is of a whitish-yellow colour, and though variable in its structure in different situations, it is nevertheless everywhere composed of small, rounded, oval, or flattened masses, enveloped by the common cellular tissue. These masses, when submitted to a more minute state of division, are found to be composed of a number of small lobules, and these, in their turn, of an infinity of minute granules or particles, closely clustered together, which have been compared to the racemose arrangement of a bunch of grapes, the blood-vessels which lead to them forming a kind of pedicle upon which the grains of fat are engrafted. From their brilliant, shining aspect, they have also been compared, by MONRO and CLOPTON HAVERS, to a cluster of pearls. Examined with a microscope of a magnifying power of from forty to one hundred and fifty diameters, the adipose granules were found by GREUSSMACHER, FONTANA, and MONRO, to exhibit an oval configuration. WOLFF represents them as being somewhat less oval than they had been described by these individuals, and HEUSINGER states that they are spherical. WEBER also found them nearly spherical in the fat taken from the socket of the eye, which he examined twenty-four hours after death. RASPAIL, however, who has instituted some experiments on this subject, states, that in the hog the granular particles of the adipose tissue are obround, and slightly elongated, or kidney-shaped, and present on their side a small oblong point, or *hilum*, by which they are attached to the cellular tissue. In the sheep and oxen, they presented a number of angles and borders, with intermediate facets, and resembled small translucent crystals of quartz; but in insects they were found to exhibit a turbinated figure, occasioned by the great depth of the *hilum* which formed their point of attachment to the common cellular tissue. From the similarity of these granules to regular polyhedrons, the author just quoted suggests that the several facets result from the mutual compression of the several particles upon each other, at their points of contact. We have ourselves verified the existence of these facets and angles in the adipose tissue of the ox and the sheep, but we are rather disposed, with WEBER, to regard them merely as an accidental condition, resulting from the solidification of the fat granules after death. These particles being soft and yielding in the living

state, it can be readily conceived, that in consequence of their encroaching upon each other during the act of becoming solid, they would thus acquire the configuration described by Raspail, which they would retain when perfectly cold.

The size of the adipose granulations has been variously estimated by different observers. Leuwenhoeck estimated it at about the size of the bulbs of the hair. Wolff, however, states that their volume varies in different animals, but that they are all of uniform volume in man. According to Heusinger, the largest are about $\frac{1}{100}$, the smallest $\frac{1}{800}$ parts of an inch in diameter; or from $3\frac{1}{2}$ to $7\frac{1}{2}$ times larger than a globule of blood. It is probable that they vary in size in the same animal at different periods of life; for Raspail found that those of the ox presented double the volume of those of the calf.

There has been considerable diversity of opinion amongst anatomists relative to the question whether the adipose tissue should be considered as a structure independent of the proper cellular tissue, or a mere secretion of fat deposited in its meshes. Malpighi, Glisson, and indeed many of the early anatomists, regarded it as a kind of glandular, or at least a secretory apparatus, destined to elaborate the animal oil. Bergin divided the cellular tissue into lamellated and adipose, the latter of which he considered as somewhat independent of the former. William Hunter, however, was the first who resorted to any elaborate arguments to prove that the fat consitutes a tissue entirely distinct from the cellular with which it is blended. This opinion has been very ably supported by Beclard, and has since been espoused by craigie, Grainger, and many other modern anatomists. Haller, nevertheless, long since maintained that the fat is merely secreted into the common cellular tissue, and does not form an independent structure. A similar sentiment has been adopted by a majority of those who have represented that the cellular tissue is of a cellular or filamentous character; some of them supposing that the fat is secreted into its cells, while others have thought that it is deposited in the interstices of its lamellæ and filaments. This hypothesis has been adopted by Prochaska, Bichat, Chaussier, H. Cloquet, Walther, Lenhossek, Hempel, and others. Wolff first demonstrated that the cellular tissue merely consists of a simple, homogeneous, gelatinous mucus, and consequently that the fat cannot be deposited in any proper cells, or between any fibres or lamellæ, but is merely lodged, as it were, in this gelatinous mucus, the particles of which are forced asunder to make room for its reception. The same view of the subject has been adopted by Heusinger, Meckel, Blumenbach, Autenreith, Rudolphi, Treviranus, and several modern anatomists.

The principal arguments adduced by Hunter and Beclard in favour of the opinion they have advocated, are the following. If the fat, say they, were merely deposited, in a free state, in the interstices of the cellular tissue, it would not assume the regular and determinate forms which it always exhibits. Moreover, when it is immersed in warm water, and is examined under a microscope, no oil is observed to float on the surface, unless such force be employed as to tear the small granules of which the tissue is composed. If it were merely a secretion deposited like water in the meshes of the cellular tissue, as it is fluid in the living subject, it should obey the same laws as that fluid in traversing the system freely from one part to another, should pit on pressure, and be capable, like the water in an œdematous part, of being forced freely from place to place. This, say they, is never observed. These arguments, however, are inconclusive, and may be rebutted by others of still greater force. Thus, if we admit, with Hunter and Beclard, that the fat should be considered as a distinct tissue, it ought to exist under all circumstances, inasmuch as we have no instance of one of the constituent tissues of the body entirely disappearing at one period, and at another assuming an extraordinary development. The fact that the eye-lids, the scrotum, and some other parts of the body, do not become loaded with fat, is not favourable to their argument, but rather corroborates the belief, that the cellular tissue, or rather the vessels of such parts, do not possess the faculty of secreting it; and if it were a proper and independent tissue, it could not, as is generally the case in anasarca, be supplanted by the inordinate accumulation of fluid in the cellular tissue.

It has already been stated, that the microscopic granulations of the adipose tissue, as well as the larger masses which are formed by their union, are all united to each other by the intervention of the delicate cellular tissue. Through this latter medium, numerous minute blood-vessels are conveyed to the granules of fat in a manner which was long since described by Malpighi, and which has, in modern times, been particularly noted by Mascagni. According to the observations of the

former, the vessels divide and subdivide, like the branches of a tree, until their final ramifications reach the small adipose globules or vesicles, which are mounted upon their extremities like the leaves of a tree. He also supposed that each vesicle constitutes a kind of secretory gland, furnished with an excretory duct, which is contained within its pedicle. Muscagni has stated, that each grain is furnished with an artery and a vein, which reach it by traversing the cellular tissue occupying the interstices of the different particles, and which consequently represent so many small pedicles, all springing from one common peduncle. These, by being distributed to the same mass of adipose granules, serve to unite them together in the same manner that a raceme of grapes are clustered together upon their stem. He also supposes that each vesicle is composed of an internal layer of lymphatic, and an external of sanguineous vessels. The arteries are exceedingly minute, yet they are sufficiently large to be filled with minute injection, especially in young subjects. Nerves have never been traced into the adipose granules, and if they exist, they must be confined to their investing cellular tissue. It was long since stated by Swammerdam, that each adipose granule is contained within a kind of vesicle or membranous covering, and when the fat is liquefied, these membranes fall to the bottom of the vessel. Braconnot also asserts that they are connected with each other by the intervention of a very delicate membranous structure, in which they are contained in the same manner as the grains of starch in a boiled potatoe. To Raspail, however, we are indebted for the most satisfactory microscopical observations upon this point. He has observed, that each mass of solid adipose substance is surrounded by a strong membranous covering or vesicle, in which no opening is perceptible. This mass is composed of an aggregate of smaller masses, likewise included within similar vesicles of a thinner and more delicate character; and these secondary masses may be divided and subdivided until they are reduced to the primitive adipose granules, which are themselves contained in small delicate membranous vesicles, so attenuated as to be imperceptible to the naked eye, but which become manifest when they are prepared by immersion in boiling alcohol, and are in this state examined with the microscope. The adipose tissue, therefore, according to this view, seems to be composed of an external vesicle, from the inner surface of which others are formed of smaller size, and these latter are divided and subdivided until they are reduced to those minute divisions, which being inflated with the adipose materials, form the primitive granules.

Should the energies of the nutritive acts be so much exalted as to give rise to a multiplication or augmentation of these microscopic elements, a corresponding increase will also take place in the membranous coverings in which they are included, and there will be, under such circumstances, a proportionate increase of the quantity and volume of the adipose tissue, as is observed in individuals who become corpulent, and especially in those in which this substance is developed in that extraordinary degree which constitutes the condition denominated polysarcia. On the other hand, however, should the demands of the system be such as to render it necessary that these adipose materials should be appropriated to the purposes of nourishing the different organs, in proportion as they are removed from the delicate membranous cells in which they are contained, they gradually collapse upon themselves, and where they have been entirely taken up by the absorbent vessels, nothing will be found remaining but the simple lamellated or filamentous cellular tissue, of which the vesicles themselves were formed. This is precisely what takes place when the individual becomes emaciated either from disease or from a privation of aliment:—the adipose elements, which are under other circumstances generated in great abundance, entirely disappear, or exist in a sparing degree, so that in extreme degrees of emaciation, not only the cellular tissue, but likewise the organs, become completely divested of fat.

The adipose tissue, therefore, seems merely to consist in a deposit of adipose or oily materials in the common cellular or mucous tissue. It is probably similar, as has been suggested by Raspail, to the common cellular tissue which forms the fecula of vegetables, from which it merely differs in the character of the materials which are deposited, these being, in the one, fat or oil,—in the other, starch. It will be seen then, that there is no foundation for the opinion of Hunter and Beclard, who, as has been already stated, supposed that the adeps constitutes a tissue entirely distinct from the cellular.

The fat sometimes exists in other forms than that which has been described. Ruysch long since supposed that he had discovered a free oil in the blood of a hog,

and MALPIGHI, GLISSON, MORGAGNI, HALLER, and several of the older physiologists, supposed that it circulates in a state of mixture with the mass of blood. This, however, has been denied by several individuals of high respectability, yet modern observations and researches have clearly demonstrated that the old opinion is correct, at least in some cases. CHEVREUL found oil in the blood, but he supposed that it merely exists there in a state of combination with the various elements of that fluid. MARCET observed oil in the blood of diabetic patients, and TRAILL discovered it in the venous blood of an individual who died of hepatitis. CLARUS, moreover, who carefully filtered through paper the blood of individuals who had died of a great variety of diseases, always found the paper transparent, and of an oily appearance. BICHAT, however, as well as BECLARD and CRAIGIE, has denied that the oil exists in its formed state in the blood, and the latter states that he had performed a number of experiments to detect these oily particles, but always without success. From this diversity of sentiment it would appear, that oil does not constantly exist in a free state in the fluid in question, yet the positive facts which have been adduced, together with the force of analogy, clearly prove, that under some circumstances, at least, it does constitute a part of the circulating fluids.

According to the observations of CHEVREUL, the fat, divested of its coverings, is composed of two proximate principles, which he has designated *Stearine* and *Elaine*. The first is a solid, whitish-coloured, almost inodorous, and tasteless substance, of which boiling alcohol dissolves about $\frac{1}{6}$ its weight. This is, however, in part deposited on cooling, in slender needle-formed crystals, while the other part is held in solution. The second is of a whitish or yellow colour, lighter than water, fluid at zero, and readily soluble in alcohol, which when boiling takes up $\frac{1}{31}$ of its weight, and even holds it in solution when cold. It may, however, be obtained in needle-formed crystals, by submitting it to a freezing mixture.

RASPAIL does not admit the existence of two proximate principles. He affirms that *Stearine* and *Elaine* are merely portions, differently obtained, of the same substance, the difference of which is merely the result of the manipulation employed. He ascertained that, by repeated and continued boiling and washing, *Elaine* was almost the only material procured.

It has already been stated, that MALPIGHI and some others maintained that the fat is secreted by a special glandular apparatus furnished with excretory ducts, destined exclusively for that purpose. This opinion, however, cannot be sustained, and was, indeed, subsequently abandoned by its author himself. HALLER adopted the more plausible hypothesis that it is separated from the blood by the extremities of the arteries; but as he supposed, on the authority of MALPIGHI, GLISSON, and some others, that the fat exists in a formed state in the blood, and has merely to be separated and deposited by the vessels, many have objected to his opinion. BICHAT attributed it to a kind of process of exhalation, and MASCAGNI has alleged that it is deposited in a crude state by the arterial capillaries, and that the lymphatics absorb its thinner parts, and leave the thicker or oleo-adipose portion behind in a state more completely elaborated. Be this as it may, the fat is unquestionably elaborated and deposited by a secretory action of the vessels, by which it is separated from the blood, and fitted for the purposes which it has to subserve.

It can scarcely be necessary to advert to the hypothesis of Sir EVERARD HOME, who has placed the origin of the fat in the alimentary canal, and who supposes that it is absorbed by the vessels of the large intestines; much less will it be necessary to notice that of KIEGEL, who imagined that it is secreted by the supra-renal capsules. These speculations are not corroborated by any conclusive facts or arguments.

With regard to the offices which have been attributed to the adipose tissue, many of them, it must be confessed, are purely hypothetical. In many parts of the system it fills up different cavities and interstices, imparts a certain degree of rotundity and symmetry, and in some situations, as, for example, the buttocks, the palms of the hands, and the soles of the feet, it serves to protect the parts under the influence of the pressure to which they are exposed. It has also been supposed to facilitate the movements of the organs, and to lubricate the surface of the skin and the articulating extremities of the bones, but these opinions are mere vague hypotheses. In consequence of its being a bad conductor of caloric, the adipose tissue has been supposed to act as a defence against cold, by preventing the escape of animal heat; and, in support of this conjecture, it has been affirmed that those animals which inhabit high latitudes are furnished with a thick stratum of fat immediately beneath the skin. It may possibly exercise some influence in this way, but this must be ex-

ceedingly limited, inasmuch as those individuals who are but sparingly endowed with this substance, endure cold quite as well as those who are corpulent. A much more plausible hypothesis is that which considers it as a store of nutritive matter kept in reserve to meet any extraordinary exigencies to which the system of the individual may be exposed. The probability of this opinion is corroborated by a variety of circumstances. We find that individuals who are submitted to protracted fasting, rapidly lose the adipose tissue, and become emaciated. The same thing takes place in disease whenever the digestive apparatus is unable to furnish the requisite quantity of nutritive matter, which, under such circumstances, is furnished by the fat. Many animals, moreover, spend a considerable portion of the year in a perfect state of torpidity, without deriving any subsistence from surrounding objects, but merely sustained by their adipose tissue, which, however abundant, it may be when they enter into this state, is always completely consumed by the time their period of hibernation has terminated. It was, moreover, supposed by Fourcroy, that the adipose tissue, in consequence of the great quantity of hydrogen it contains, contributes to render the products of assimilation more nutritive, by divesting them of a proportion of that material.

§ 2. *The Medullary Adipose Tissue.*—Besides the general adipose tissue which has been just described, we find lodged within the cavities of the cylindrical bones a considerable quantity of the same substance, which, in this situation, is denominated *medulla ossium*, *meditullium*, or *marrow*. This substance, however, is not confined to the cavities of the long bones; for while we find it presenting an elongated cylinder accurately moulded to the inner configuration of these cavities, it also exists in their reticulated structure, in that of the short, as well as in the substance of the flat bones. It exists, likewise, to a certain extent, in the porosities of the compact osseous tissue, but is never found in those cells of the bones which are destined to circulate air, as those of the mastoid process, the frontal sinuses, the ethmoid cells, &c. It may also be discovered in the cells of the thyroid cartilage of the larynx, when it becomes ossified; but, according to Weber, it never exists in that structure while it retains its cartilaginous condition.

In the medullary cavities of the long bones, the marrow is of a more solid and thick consistence than in the other portions of the osseous system. It is of a lightish yellow colour, and is contained within a very delicate vascular membrane, denominated internal periosteum, or medullary membrane, which, while it lines the cavity of the bone, and sends numerous very minute prolongations upon the vessels which permeate the porosities of the osseous tissues, is also so disposed as to form an infinity of small cells, in which the adeps or marrow is deposited. This membrane is of a texture so exceedingly delicate, that it can be with difficulty observed by the naked eye. By submitting it to heat, however, or immersing it in nitric or muriatic acid, it can be detached from the bone, and being at the same time rendered opaque, can be distinctly seen occupying the surface of the medullary substance, in form of a very fine pellicle, which has been not unaptly compared by Beclard to the *tunica Arachnoidea*. It may, moreover, be still more satisfactorily demonstrated by the plan proposed by Weber. If a section of one of the long bones containing the marrow be, in its fresh state, immersed for some time in diluted muriatic acid, the carbonic acid gas which is liberated from the inner surface of the bone will gradually break up the attachments of the membrane with the osseous tissue, and it, together with the marrow, may be withdrawn from the cavity in form of a perfect solid cylinder.

The numerous minute cells formed by the ultimate subdivisions of the medullary membrane, when filled with the oily or fatty substance of which the marrow is composed, gives rise to an arrangement which seems to be composed of an infinity of minute, lightish coloured, rounded, or oval granules, which have been very accurately compared to a cluster of small pearls. They are closely agglomerated together, and bear the same relation to the cells or divisions of the medullary membranes, that the common fat granules do to the cellular tissue which furnishes them with a covering. It is, indeed, highly probable, that the investing membrane of the medullary granules is of the same nature as the common cellular tissue, rendered somewhat more vascular in this situation in consequence of the peculiarity of its relations.

In the reticulated structure of the bones, the medullary substance exists for the most part in form of a free oil, placed in immediate contact with the osseous tissue, and consequently entirely devoid of any investing membrane; at least if the mem-

brane exists, it is probably a mere vascular arrangement, by which the fat is elaborated and poured out, and again absorbed.

The medullary membrane is abundantly supplied with vessels. These vessels were long since well described by Albinus and Duverney. They are mostly derived from those branches which traverse the nutritious foramina of the bones, which, after they have entered the medullary canal, branch out into an infinity of ramuli, which are distributed upon the medullary membrane and its numerous divisions. They seem, moreover, to form a very free anastomosis with the proper nutritive vessels which occupy the porous arrangement of the bones, and thus prove instrumental in establishing an intimate connexion between the medullary membrane and the periosteum. When these vessels are filled with minute injection, and the marrow is carefully washed away by means of an alkaline solution, the medullary membrane seems to be composed almost entirely of a delicate net-work of minute arteries and veins.

With regard to the question whether the marrow is supplied with nerves, many anatomists of distinction have replied in the negative, and even Meckel, while he affirms that the medullary substance of the bones is sensible, states that he had been unable to discover any nerves entering it. These nerves, however, have been particularly noticed by Wrisberg and Klint. Sœmmering admits their existence, but supposes that they are destined exclusively for the vessels; but J. Cloquet has traced the minute filaments of the ganglionic nerves, accompanying the nutritious artery of the humerus, into the marrow. Beclard, moreover, supposed that they might supply both the vessels and the other structures of the marrow.

But be this as it may, the marrow is unquestionably endowed with considerable powers of sensibility. This was long since proved by the experiments instituted by Duverney, the results of which have been confirmed, in modern times, by the researches of Bichat, Meckel, and others. It has been affirmed by Bichat, that the sensibility of the marrow is most exquisite the nearer we approach the centre of the bone, and least towards its extremities. This has not been confirmed by Meckel. But while there can be but little doubt relative to the existence of this sensibility, it has doubtless been very much exaggerated by some writers, and especially Bichat; for Lebel, in extracting a large sequestrum, had occasion to expose a considerable portion of the marrow, the membrane of which was red and highly inflamed, yet the individual did not complain of pain from the injury inflicted upon that substance.

The medullary, like the general adipose tissue, does not exist during the early months of the fœtal life. There is no medullary canal in the cartilaginous bed of the bone when it is first formed, but in proportion as the development and the process of ossification advance, this canal becomes distinct, traversed at first by blood-vessels, but afterwards occupied by the medullary membrane, which is filled by a reddish-coloured, viscous, or gelatinous substance. Finally, small vestiges of adipose substance can be observed in the midst of this mass, and after the expiration of a certain period the whole of the gelatinous substance is supplanted, as it were, by the marrow, which then fills up the whole of the medullary canal. Still, however, according to Isenflamm, in a child of a year old the cavity of the bone was merely occupied by a darkish, red-coloured, gelatinous substance, traversed by numerous blood-vessels. As age advances, the medullary canal and the marrow which occupies it, increase in volume, and the latter assumes a deeper yellow colour. Its quantity, however, varies very much under different circumstances, and seems to be influenced, in this respect, by the same laws that modify the general adipose tissue. In a medium state of *embonpoint*, Beclard found the marrow composed of seven parts of fat out of eight, the vessels, water, and albumen only constituting one part. In those who were much emaciated, however, he scarcely found the oily or fatty matter forming one-fourth of the entire substance. The same fact has also been noticed by Isenflamm. The marrow is, moreover, greatly diminished in quantity, or entirely disappears, under the influence of particular diseases. Thus, in dropsy of long standing, its quantity has been found notably diminished, and, according to Sœmmering, it is sometimes completely supplanted in that disease by a kind of bloody gelatinous fluid. The same condition of the marrow has been observed by Bichat in rickets. In jaundice, the medullary substance, like many of the other solids and fluids of the body, is tinged of a deep yellow hue by the bile.

The medullary membrane seems to be concerned in the two-fold office of contributing to the nutrition of the bone, and the secretion or elaboration of the fatty materials of the marrow. It has been ascer-

tained by the experiments of Troja, that when this membrane is destroyed the corresponding portion of the bone falls into *necrosis*. But as regards the use of the marrow itself, the opinions of authors are more divided. It was supposed by Duverney that the oily parts of the marrow served to impart flexibility and toughness to the bones,—an opinion which has also been adopted by Haller and Blumenbach. In corroboration of this opinion, it has been alleged that when the bones have been deprived of their oily matter, by submitting them to heat, they are rendered highly fragile, and that after they have been thus prepared, if they be immersed or boiled for some time in oil and gelatine, and subsequently allowed to dry, they regain, to a considerable degree, their former strength. It should be subjoined, however, that by the process of calcination the bones are not only deprived of their oil, but likewise their animal matter, to which they owe most of their cohesiveness and their capability to resist injuries, and that although they are afterwards rendered stronger by the process just mentioned, it is not in consequence of their former properties being restored, but from the development of new combinations, differing, in many essential particulars, from bone. Against this hypothesis it may, moreover, be urged, that the medullary adipose tissue does not exist in the bones of the fœtus, and but sparingly in those of very young persons, yet these structures are by far more tough and flexible at this than at any subsequent period of life; and in old persons, in whom this tissue is very abundant, the bones, instead of being rendered more capable of resisting the influence of the accidents to which they are exposed, become so exceedingly fragile as to be broken by the slightest causes. In birds, moreover, the long bones, instead of being filled by marrow, are merely occupied by air, yet, in proportion to their volume, they are even stronger than those of animals in which the medullary adipose tissue largely abounds.

The following conjectures relative to the uses of the marrow are much more entitled to confidence. One office of the excavations of the bones seems to be to render them lighter, at the same time that they serve to increase their strength. The marrow which occupies these cavities may be considered as bearing the same relations to them that the general adipose tissue bears to the organs and tissues with which it is connected. It fills up the cavities and interstices of the bones, and at the same time constitutes a store of nutritious matter in reserve to meet any exigencies of the system. It may serve, moreover, to afford a means of protection to the delicate network of vessels which enters so largely into the formation of the medullary membrane, which, did they exist in a mere void cavity, would be liable to sustain considerable injury by the violent shocks and contusions to which the bones are constantly exposed.

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Art. II. Adipose Tissue, *Pathological Anatomy of.*—From the views which we have expressed relative to the properties of the adipose tissue, it would be more in accordance with a natural arrangement to describe its pathological characters in connexion with the alterations of nutrition and secretion in the cellular tissue, to which they more properly belong. But as we

have, in compliance with common usage, made a separate article on that tissue, we shall in like manner subjoin a short exposition of its principal pathological conditions.

a. Preternatural development of the adipose tissue. (*Hypertrophy.*)—The fat varies materially in quantity in different individuals, and even in the same individual, under different circumstances. Hence it is difficult to determine what degree of increase should be regarded as pathological, and what merely the result of healthy secretion and nutrition. It was estimated by QUESNAY, that in a healthy individual weighing 160 pounds, there should be 8 pounds of fat, and that any considerable departure from this standard, either in the way of increase or diminution, should be considered as evincing a tendency to disease. Such estimates are, however, altogether arbitrary, inasmuch as we find the quantity of adipose substance very frequently departing considerably from this proportion, without giving rise to the slightest disturbance of the general health, or occasioning any inconvenience to the individual. It is only when its excess or defect are very inordinate, that they are regarded as resulting from a pathological state, and even then it is difficult to determine with accuracy what should be regarded as disease; for we not unfrequently find the most corpulent enjoying the most perfect health, and only suffering inconvenience from the enormous bulk of their body.

The inordinate development of the adipose tissue may be either general or partial. In the first case, it accumulates in an unusual quantity in all the situations in which it is usually found; in the second, in one or more organs. The first constitutes *Polysarcia*, some very remarkable examples of which exist on record; the second forms tumours of an adipose character, which have been variously designated *Lipoma*, *Steatoma*, *Physconia adiposa*, &c. To these forms must also be added a third, in which there is a species of transformation of some of the other tissues into fat. This is particularly well exemplified in the adipose transformation of the substance of the heart and the muscles of animal life, the liver, the ovaria, testicles, &c., which frequently takes place in advanced life.

The degree to which the size and weight of the body is sometimes increased by an accumulation of fat would appear incredible, were it not that satisfactory exemplifications come so frequently within our notice. This even takes place, in some instances, at an early period of life. TULPIUS has reported the case of a child, who, when only five years old, weighed 150 pounds; ESCHENMAYER, one of ten years of age, who weighed 219 pounds; BARTHOLIN, one of eleven, 200 pounds: and two other cases have been reported, one by the French faculty, who, at the age of four years, weighed 104 pounds; the other in the Philosophical Transactions, who, at the same age, weighed 256 pounds. Bright, also, who at a later period weighed 616 pounds, at ten years of age, weighed 140 pounds. Sporner weighed 649 pounds; Van Leenwarden, 503; Ahrens, 450; and an individual, whose case is reported in *der Sammlung auserlesener Wahrnemungen*, 3 Band. p. 370, weighed, at his death, 800 pounds: the fat of the abdomen was from 13 to 14 inches in thickness. He was carried off by a spontaneous salivation, or, as represented by some, by fright. Two cases are also reported by SENNERTUS, one of whom, at thirty-six years, weighed 480 pounds; the other, 600. Of the same kind was the case of LAMBERT; and many similar have been recorded.

Where this extraordinary development of fat takes place, the adipose matter is not confined to the superficial and interstitial cellular tissue, but is likewise deposited in enormous quantities within the splanchnic cavities; especially about the heart, in the mediastinum, around the kidneys, and in the omentum. In many cases, however, instead of being thus extensively diffused, it is confined, for the most part, to the cavity of the abdomen, and then gives rise to the condition denominated *Obesitas*, or by some *Physconia adiposa*. In either case, when the development of fatty substance is very considerable, it encroaches upon the organs, and gives rise to great embarrassment of their functions.

As we have already expressed our belief that the fat is deposited by a secretory process of the vessels, or of the cellular tissue in which it is lodged, it is evident, if this opinion be correct, that its preternatural accumulation must depend, either upon an increased activity of the parts concerned in its elaboration, an enfeebled action of the absorbent vessels which are employed in its removal, or the united agency of these two causes. But, notwithstanding we may satisfy ourselves thus far, relative to the cause of the condition under consideration, the precise condition, or conditions, of the organism concerned in its development is not so easily determined. BEDDOES supposed that one cause might be a defect of oxygen in the system, and it is remark-

ed by Good, that fat unquestionably contains less oxygen than muscle, and that sea-scurvy, in which the oxygen is perhaps reduced to its smallest proportion, is never announced by meagerness, but fullness of habit, which is often its first symptom. This is corroborated by the observations of Trotter, who affirms that when a negro becomes rapidly corpulent, he never fails to fall a prey to sea-scurvy. There are, moreover, other circumstances which favour the truth of this conjecture; as, for example, the condition of hibernating animals, or those which, during the cold season, remain in a state of torpidity, in which the respiratory function is so far suspended that a sufficient supply of oxygen is not afforded to effect the usual changes in the blood, and the carbonacious matter, as well as the hydrogen, which in the natural state are thrown off by the lungs, and which form the predominant ingredients of fat, are suffered to accumulate in the system, and thus furnish a sufficient quantity of nutritive matter in reserve, to sustain the life of the animal during its season of inactivity. It has, moreover, been remarked by Von Græfe and others, that the respiratory apparatus of corpulent individuals is less perfectly developed than in others, and that the liver, spleen, and indeed all the abdominal organs, have been found unusually large. This fact, therefore, may either be construed in favour of the hypothesis of Beddoes, or of that which has been adopted by many modern physiologists—that one of the offices of the liver and spleen is to separate carbon and hydrogen from the blood, and that whenever any impairment of this office occurs, a preternatural accumulation of fat takes place, in consequence of the retention of those two materials. In favour of this latter opinion, the facts may be urged, that animals usually become fat after the extirpation of the spleen; that some chronic affections of the liver create the same condition; that a free and continued use of those substances which contain an abundance of carbon and hydrogen, (alcoholic potations for example,) not only excite corpulency, but likewise give rise to an enlargement of the liver; and, finally, the fact stated by Græfe, that the latter organ is preternaturally large in those who are affected with extraordinary obesity. The offices of the skin, of the kidneys, testicles, &c., seem, moreover, to have some agency in its development. It has been remarked by Bichat, that during a fog of twenty-four hours' duration, thrushes, ortolans, and red-breasts, become so fat that they are scarcely able to get out of the way of the sportsman; and the influence of castration in giving rise to corpulency is well exemplified in eunuchs and various domestic animals. In addition to this, it may be alleged, that as the respiratory function seems to have some agency in the process, there is probably some modification of the act of sanguification, by which the blood is rendered less appropriate for healthy nutrition, and acquires a preponderance of carbon and hydrogen. There seems, also, to be some peculiarity in the relative development or energy of the ganglionic and cerebro-spinal nervous systems; the latter, especially, being characterized by a want of power or activity; from which circumstance such individuals are mostly of a sluggish or leuco-phlegmatic habit, slow of comprehension, and oftentimes not altogether undeserving the appellation "fat and stupid." It has, indeed, been correctly remarked by Bichat, that inordinate obesity should rather be regarded as an evidence of a want of energy of the system, and a sluggish activity of the absorbent system, than of an opposite condition; a fact which is fully corroborated by the declaration of Trotter, to which we have already referred.

When the preternatural development of the adipose tissue is confined to some particular portion of the body, it gives rise mostly to the formation of tumours of variable size and configuration, which have been denominated *Lipoma*, *Steatoma*, *Adipose sarcoma*, &c. They are generally situated in the subcutaneous cellular tissue, but are likewise frequently found within the abdominal cavity, in connexion with the peritoneum. Though sometimes small, they have been seen weighing as much as fifty or sixty pounds; forming an enormous mass attached to the back, buttocks, or even to the face and other parts of the body. They are at first generally obround, and slightly compressed, but when they form upon parts of the body where the skin and cellular tissue are lax and easily elongated, they often become pyriform, or pediculated, and are merely suspended by means of a small neck, consisting of the elongated skin and a small quantity of fat. They are also frequently lobulated upon the surface, and seem to consist of an agglomeration of rounded masses of fat, the irregularities of which can be felt through the skin. It is found, indeed, on cutting into them, that, in this respect, they do not differ from the natural adipose tissue; being, like it, composed of several rounded masses of fat loosely grouped together, and united by the intervention of the common cellular

tissue, which, while it forms a condensed covering, or capsule, investing their whole surface, sends numerous partitions through the substance of the tumour, which furnish a kind of secondary covering for each of its divisions. This covering, as well as the partitions, is generally traversed by a few blood-vessels, which furnish the only circulation with which the tumour is supplied; and when the size of the diseased mass is considerable, the investing cellular tissue generally becomes hypertrophied or thickened, so as to render it more compact and resistant. These primary masses, like those which belong to the natural adipose tissue, may be divided into others of smaller size, and these again into the primitive adipose granules, which, as has been remarked by Monro and Beclard, do not differ from those which exist in the natural state. In their organization, therefore, they do not differ from the healthy tissue. (See *Tumours.*)

Those which form in the cavity of the abdomen, often attain a considerable volume, and are more frequently pediculated than those which are developed externally. They may take place either in the omentum, in the epiploic appendages, or beneath the peritoneum, and when situated in the vicinity of the linea alba, or any of the natural apertures of the abdomen, they may protrude, and give rise to an *adipose hernia*, or *liperocele.* Those which are developed exterior to the peritoneum, are but sparingly supplied with blood-vessels, and are so loose in their arrangement, that they can frequently be spread out like a portion of the omentum. (See *Abdominal tumours.*)

Sometimes small encysted tumours are formed beneath the skin, and even in the substance of the organs, which contain a fatty or oily material, much softer than the substance which constitutes the tumours just described. The animal oil, indeed, frequently exists merely in form of small particles, floating in a darkish-coloured melicerous fluid; sometimes mixed with small fragments of tuberculous matter, and occasionally contained in small cells, formed by the common cellular tissue somewhat condensed. In some instances, the contents of the cyst possess more of the properties of adeps, and are disposed in masses of a more solid consistence, but still much softer than common fat. These masses are merely attached to the walls of the cyst by minute blood-vessels and delicate shreds of the filamentous tissue, and may be turned out with great facility, leaving the walls of the capsule entire. They are formed most frequently on the back, the scalp and face, about the eyelids, and occasionally in the ovaria.

With the preternatural development of the adipose tissue, must likewise be enumerated its deposition in the interstices of some of the tissues and organs, and in situations which it does not naturally occupy. These conditions have been incorrectly described by some pathologists under the appellation of adipose degenerations. In accordance with the views of Beclard, we are disposed only to regard them as examples of the accidental development of fat. When this takes place in the interstices of the muscles and other tissues, the natural structure of the part becomes atrophied, and is partially or entirely supplanted by the encroachment of the fat. This is observed in the adipose transformation of the muscles, heart, liver, &c., which so frequently occurs in advanced life; in the deposition of adipose tissue in the scrotum and ovaria, after castration, or after those organs have been wasted or destroyed by disease, within the cranium, on the internal surface of the mucous membrane, and in other situations in which it is not found in the natural state of the organs. (See *Path. Anat. of the muscles.*)

b. Preternatural deficiency, or Atrophy of the adipose tissue. A deficiency of the adipose tissue is far more frequently observed than the opposite condition. It occurs in different degrees, from a slight diminution to an entire absence of all appreciable evidences of fat possessing its usual characteristics. The first is of frequent occurrence, and may be induced by a variety of causes; the second is but rarely met with, and probably never takes place, except as a consequence of long-protracted diseases, or profound organic lesions involving structures essential to life. There are, indeed, but very few cases in which the adipose tissue is entirely annihilated, and probably none in which visible indications of free oil may not be detected in some portion of the system, however extreme the emaciation. It has been remarked by William Hunter, that anasarcous dropsy is the only condition which is capable of completely removing the adipose tissue, and that in those individuals in which this disease is inveterate, the heart and mesentery are often found as free from fat as in the youngest children. Bichat, however, has correctly observed, that the adipose substance and the serosity do not of necessity mutually exclude each other, since in most cases of anasarca, even where the infiltration is very great,

a considerable quantity of subcutaneous adeps may still be recognized. (I. 77.) This we have had repeated occasions to observe, even when the cellular tissue has been completely loaded with water: the fat under such circumstances being converted into small dark, gray, coloured pellets, not dissimilar in appearance to the substance of a common slough of the cellular membrane. In phthisis pulmonalis, moreover, in tabes mesenterica, and, in short, in most diseases attended with extreme emaciation, portions of fat may be found occupying some of the tissues; and even in those individuals who have undergone such a degree of atrophy as to entitle them to the appellation of walking skeletons, more or less fat still exists, either in a formed state, or in the condition of a free oil. In such cases, the latter may always be found in the bones, infiltrated with some of the tissues, or mingled with some of the circulating fluids.

The principal causes of this *atrophy* of the adipose tissue are, long-continued fasting, as is exemplified in hibernating animals, or a defective or unwholesome alimentation; profound organic lesions of parts essential to life; extensive purulent depositions; the influence of the depressing passions; long-continued and intense application; excessive evacuations either of blood, or of the secretions of the body; exposure to intense heat; great bodily fatigue or laborious exertion; protracted diseases, especially such as involve the nutritive or respiratory acts; long watching or loss of sleep, &c. &c. A state of anæmia either arising from a defective sanguification, or any other cause, always induces this condition.

d. Alterations of texture taking place in the adipose tissue. It has been questioned by some whether the adipose tissue is susceptible of inflammation. The filamentous or cellular tissue which invests it and occupies the interstices of its pellets and granules, is certainly liable to be thus affected; and it was long since very correctly remarked, that inflammation taking place in a part greatly abounding with fat has a remarkable tendency to terminate in gangrene and sloughing. This is often observed in the omentum, when protruded into a hernial sac; in the mass of adeps which surrounds the anus, and in various other situations. It has, moreover, been remarked by Craigie, that the adipose cushion which surrounds the vessels, is sometimes the seat of a bad inflammatory action, terminating in fetid and sloughy suppuration. He subjoins an example of inflammation of the adipose cushion of the kidney, in which the whole of this substance was converted into an ash-coloured, fetid, semi-fluid pulp, mixed with shreddy filaments, and in which the sloughing process had opened a passage from the fat of the left kidney into the interior of the arch of the colon. A similar instance is reported by Turner in the fourth volume of the Transactions of the College of Physicians. Craigie seems to think, that the influence of this tissue may have some participation in the development of the peculiar phenomena of diffuse cellular inflammation. (*General and Path. Anat.* p. 62. Edinb. 1828.)

When inflammation attacks a part containing much of this tissue, as after wounds and operations, the fat is speedily removed by absorption, merely leaving the cellular tissue and other parts with which it is blended to effect the reparation of the breach. The same phenomenon is observed in the medullary adipose tissue after fractures, amputations, and other injuries involving the substance of the bones. At the point at which the fracture occurs, and in its immediate vicinity, the marrow is speedily removed, and the vascular medullary membrane pours out a peculiar plastic lymph, which, in becoming solid and ossified, fills up the corresponding portion of the cavity, until the consolidation of the fracture is completed, and is then absorbed, in its turn, to give place to the marrow, which is again deposited by the vessels of the membrane. (See *Fractures.*)

The medullary adipose tissue, like that which is situated elsewhere, is liable to some variations as regards quantity. It is diminished in hydropic affections, and in various other diseases attended with extreme emaciation. We have repeatedly seen it almost entirely destroyed in the large cylindric bones in persons who have been a long time affected with syphilis, and its place supplied by dark, red-coloured sanies; sometimes by a fluid of the consistence of honey. The medullary membrane, under these circumstances, has been found entirely destroyed, and the internal part of the bone carious or necrosed.

In the disease called spina ventosa, or medullary exostosis,—also, in internal necrosis, and medullary abscess, the marrow is destroyed, and the medullary membrane is either disorganized, or submitted to important changes of structure. Indeed, these diseases generally have their origin in this membrane, and not in the proper substance of the marrow, as has been

sometimes asserted. It is remarked, moreover, by Beclard, that in persons affected with rickets, the membrane of the marrow is frequently found thickened and indurated. This, however, as well as the carcinomatous degenerations which occasionally occur within the cavity of the bones, cannot properly be considered as diseases of the adipose tissue, but of the membrane by which it is invested.

Those organic alterations which have been described under the appellation of lardacious degenerations, have no properties in common with the adipose tissue. They merely consist of a state of hypertrophy of the common cellular tissue, and need not be described in this place.

The fat itself does not seem to be capable of undergoing any proper degeneration; but in some rare instances it may become the seat of accidental developments. In animals especially, it not unfrequently has various entozoæ generated within its substance, and even in the human subject these animals are found in it. In a female, aged twenty years, who died of apoplexy after a difficult labour, Trentler found within the left ovaria a hard tumour, about the size of an ordinary nut, composed of cellular and adipose substances, in the midst of which there was a small cavity as large as a pea, in which was discovered a living worm. When taken out and put into water, it was observed to move. He has described and figured it under the appellation of *Hexathyridium Pinguicola;* (*Obs. anat. path.* p. 19.) but it has been since described by Zeder and Rudolphi, under the name of *Polystoma Pinguicola.* (*Rudolph. Entozoor. Hist. Nat.* II. 455. Amst. 1809.)

E. Geddings.

ADIPSIA. (From α, priv. and διψα, thirst.) Absence of thirst. I. H.

ADJUVANT. (From *adjuvare*, to aid.) An auxiliary. A medicine added to a pharmaceutic preparation, to aid the action of the principal ingredient or basis. I. H.

ADNATA. Epithet formerly applied to the conjunctiva. I. H.

ADOLESCENCE. (See *Age*.)

ADULT. (See *Age*.)

ADULTERATION. (From *adulterare*, to alter or falsify.) The sophistication or alteration of articles, so that they appear of good quality without having the efficacy they should possess. More space would be required than is consistent with our plan to devote to it, to point out all the frauds that are practised in the trade of drugs and pharmacy. The principal adulterations and substitutions, however, will be noticed under the head of each article. I. H.

ADVENTITIOUS. Accidental or acquired. Said of diseases which are neither constitutional nor hereditary. Also of tissues which result from a morbid action. I. H.

ADYNAMIA, ADYNAMIC. (From α, priv. and δυναμις, strength.) The term adynamia has been employed in various significations. In its general acceptation, and from its etymology, it is perfectly synonymous with *Debility*, and as this word is the most common, and least likely to be misunderstood, it will be best, in accordance with our plan, to treat of the subject under this last head. It is proper here, however, to explain briefly the significations which have been attached to the term Adynamia by the principal nosologists.

Vogel has grouped together in one class, upon which he has bestowed the term adynamia, all cases of diminution or abolition of energy in the sensations, in *voluntary* motion, and in the natural functions; and he has, moreover, especially given it to one genus of this class, which comprises all cases of extreme debility, in which the patients are incapable of moving in bed, or of supporting themselves in a sitting posture.

Cullen, in his nosology, has bestowed the name adynamia upon an order of diseases, the characters of which are, "a diminution of the *involuntary* motions, whether vital or natural." Thus he differs from Vogel, in not comprising under this head either the diminution or abolition of the sensations, or that of voluntary motion; and, on the contrary, he ranges under it the diminution of involuntary movements.

Pinel employed this word to express the excessive muscular debility attendant upon certain fevers commonly termed *putrid*, and for which epithet he substituted that of adynamic. This innovation was generally adopted in France, and the employment of the term became very common. The school of this distinguished professor, in applying the term to a particular febrile condition, of which it indicated, as they believed, the nature and principal character, made adynamia in fevers an important point of doctrine, and one of the questions which was long the subject of controversy.

Finally, in recent times, some physicians have bestowed the epithet adynamia upon that state of stupor and of general and extreme debility which accompanies gangrene of internal organs, and in some cases gangrene of external parts, the action of very deleterious gases, and that of miasma when violent.

"Struck," observes M. Roche, "by the apparent state of adynamia observed in some diseases, and the more so as the state of the science rarely permitted them to ascertain the proximate cause of these affections, and to discover their nature—influenced by the terrors of patients, in whom debility always caused great alarm—and misled by false theories, physicians long regarded muscular weakness, the diminution of the sensations or of the energy of the functions, in a word, adynamia, as the principal thing in most diseases—as the disease itself. In consequence of this idea, they have sought for therapeutic means, in stimulating, tonic, and irritating substances, to remedy what was almost always a symptom only, and hence arose that incendiary treatment, of which we happily see nothing but the vestiges in the practice and writings of physicians of the present day. It is not one of the least of the services which M. Broussais has rendered to science, his having demonstrated that adynamia is scarcely ever essential, that in a great majority of cases it is the symptom of an internal inflammation, that its degree is in proportion to the intensity of the inflammation and the importance of the organ affected, and finally, that the best means of relieving it is to remove by an antiphlogistic treatment the phlegmasiæ which induce it." (*Dict. de Méd. et de Chirurg. Prat.*)
I. Hays.

ÆDOIODYNIA. (From αιδοια, organs of generation, and οδυνη, pain.) Pain in the organs of generation. I. H.

ÆDOITIS. (From αιδοια, organs of generation.) Inflammation of the external organs of generation. I. H.

ÆDOPSOPHIA. (From αιδοια, organs of generation, and ψοφος, noise.) The discharge of air from the urethra in men, and from the vagina in females. I. H.

ÆGILOPS, *Ægylops*, *Egilops*. αιγιλωψ. (From αιξ, a goat, and ωψ, an eye.) This epithet was given by the Greeks to an ulcer seated over the lachrymal sac, but not communicating with it; and which usually resulted from the opening of a small abscess of this part. (See *Anchilops*.)
I. H.

ÆGOPHONY, *Egophony*. (From αιξ, a goat, and φωνη, voice.) *Voix chevrotante*, goat's voice. This epithet has been bestowed by Laennec upon the tremulous or subsultory sound produced within the chest by the voice, as heard on the application of the ear to the chest; when the natural resonance of the voice in the bronchial tubes is rendered more distinct by the compression of the pulmonary texture, and modified by its transmission through a thin layer of fluid, between the lamina of the pleura, in a state of vibration. (See *Auscultation of the voice.*) I. H.

AERAPHOBIA. (From αηρ, air, and φοβος, fear.) Dread of the air. This symptom is not unfrequently attendant upon hydrophobia, hysteria, and other nervous affections. I. H.

ÆRUGO. (From *æs*, copper.) The oxide of any metal, but more particularly applied to that of copper. (*Aerugo æris.*)
I. H.

ÆSCULUS, Horsechestnut, Buckeye. *Ropkastanie*, Germ.; *Ippocastano*, Ital.

Sex. Syst. Heptandria Monogynia. *Nat. Ord.* Hippocastaneæ.

Gen. Ch. *Calyx*, ventricose. *Corol.* 4 to 5 petals, unequal, pubescent, inserted into the calyx. *Caps.* 3-celled. Persoon.

This genus is composed of but few species, most of which are natives of the United States, where they are known under the name of Buckeye. Only one of these plants has been used in medicine, though it is probable that they are all endowed with similar properties.

Æ. hippocastanum, Linn. *Marronier d'Inde*, Fr. *Sp. Ch.* Leaves digitate, leaflets 7; flowers in terminal pyramidal spikes.

This species, which is common in gardens and public walks in Europe, and is not unfrequently cultivated in the United States, is a native of Asia. It was first introduced into Europe in 1615, and the original plant brought to Paris was to be seen a few years since in the garden *de Soubise*. (Merat et De Lens.) The parts used in medicine are the bark and the fruit, especially the former, which early attracted the attention of physicians as a bitter tonic and febrifuge, and for many years no doubt existed as to its possessing these powers in an eminent degree. When, however, the general war in Europe obliged the continental nations to resort to indigenous substitutes for cinchona and other foreign drugs, a course of experiments was undertaken in France, to ascertain the real value of the horsechestnut bark as a febrifuge, which presented the most contradictory results; for, whilst in the hands of some practitioners, it proved most eminently successful, others declared that it was wholly inefficacious in the cure of paroxysmal diseases. From a careful comparison of these contradictory accounts, it would appear that although the bark of the horsechestnut is indubitably endowed with the properties of the bitter tonics, and may be useful in some cases, it can by no means

be considered as a substitute for cinchona. It is the bark of the young branches only that is used; this is to be gathered in the spring, deprived of its epidermis, and dried. In this state, it is in thin pieces, of a reddish brown colour on its external surface, but paler within, of an astringent and slightly bitter taste. The dose in substance is about a drachm. It is also given in decoction, extract, &c. It has been analyzed by several chemists, as HENRY, VAUQUELIN, PLANCHE, &c.; the latest examination of it, however, is that by PELLETIER and CAVENTOU, who found that it contained a reddish astringent substance, a greenish oil, a yellow colouring matter, an acid, gum, &c., but no alkali or fecula. The fruit is bitter and disagreeable, but is eaten by some animals. It contains a large proportion of fecula, which, when freed from the bitter principle, is an excellent substitute for arrow-root. This fecula also forms a paste of great tenacity, and which has the additional advantage that no insect will attack it, and is hence well suited for book-binders, &c. The fruit, when dried, is also used to make issue peas. Mr. F. CANZONERI, of Palermo, has given an account of a peculiar principle which he detected in the nuts of the horsechestnut, and terms *Æsculine*. More recent observations, however, have proved that this substance is only a kind of extract, containing sulphate of lime.

The American species, which belong to the sub-genus *Pavia*, are in all probability possessed of nearly the same properties as the *Æ. hippocastanum*. Their fruit is, however, endowed with more activity, as, when fresh, they will intoxicate fish.

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R. E. GRIFFITH.

AFFECTION. (Phys. Path.) The different changes or modifications which the mind or body may experience. It is also employed synonymously with *disease.* (q. v.) I. H.

AFFECTIVE FACULTIES. The propensities and sentiments are so denominated by GALL and SPURZHEIM. (See *Faculties.*) I. H.

AFFERENT. (From *affero*, I bring.) The vessels which convey lymph to the lymphatic glands are so termed. I. H.

AFFINITY. Proximity, suitableness, conformity of things to one another; resemblance of objects in form, exterior habitude and structure. Employed in chemistry to express the force which, acting upon the particles of matter at insensible distances, causes them to unite and combine with each other exclusively, or in preference to any other combination, and which maintains them in union. (See *Attraction.*)

It is also used in physiology, (*vital affinity,*) to designate the force which governs the various compositions and decompositions in living bodies, and which is believed to be often opposed to chemical affinity. It is probably the same force, its results modified by the peculiar apparatus or structures in which the changes are effected, or by the circumstances under which the particles are brought in proximity so as to act upon one another. (See *Force.*) I. H.

AFFLUX. (From *affluere*, to flow to.) A flow or determination of humours towards a part. See *Fluxion.*

AFFUSION. *Affusio*, Lat. (From *affundere*, to pour upon. A therapeutic agent, which consists in pouring a fluid over the whole or a part of the body. River or spring water is usually employed, though salt and sea water are sometimes used.

Affusion differs from the other modes of applying water to the surface of the body, less in effect than in form. Thus in what is termed *aspersion*, the fluid is projected in drops like rain; in *immersion*, a part, or the whole of the body is entirely plunged into it; in the *douche*, the fluid is made to strike upon some particular part in a continuous manner, and with a certain force; in the *shower-bath*, it falls in a sudden shower upon the head and upper parts of the body, &c. The temperature of the water used being generally from 56° to 66° Fah., affusion may be regarded as almost exclusively a refrigerating process, always implying the use of cold water, unless warm be expressly mentioned.

When the application is made in a general way, the patient is usually seated naked in an empty bathing-tub: if he be too weak to support himself, he should be laid upon a sheet, and held over the tub by assistants. This last plan will likewise

be requisite, when the affusion is to be specially directed upon the abdomen and genital organs. The state of the pulse and heat of the body must be examined and noted, and the quantity and temperature of the water required, properly adjusted. A few drops may at first be sprinkled upon the face, after which a continued stream may be poured from a bucket or other wide-mouthed vessel, in the beginning rather gently, and afterwards suddenly, and so directed over the body as not to occasion a painful shock. To effect this last object, it will be best to direct the stream first upon the shoulders and back, as these parts are less sensitive to the impression of cold water than the front of the body. After this, the stream may be directed upon the top of the head, and finally upon the more susceptible parts in front. An interval of some seconds is generally interposed between each affusion, as by making them with little or no intermission, they may create too much uneasiness to the patient; and if directed upon the head, interfere with respiration. After a sufficient application, the extent of which is to be determined by circumstances yet to be explained, the patient is to be well dried with warm towels, wrapped in a warm sheet, and placed in bed.

When it is requisite to apply the affusion to the head only, a cape of oil-cloth, or other suitable material, may be put around the neck, which, with the superior parts of the trunk, have been previously so enveloped as to protect them from the impression of the cold water. When it is deemed necessary to produce a determination to the inferior parts of the body, the patient may be placed on a stool in the bathing-tub with his feet in warm water, or even immersed to the hips in a tepid bath.

The primary effect of affusion is to produce a sudden and general shock, succeeded by a diminution of the heat and sensibility of the surface. The skin contracts and loses its colour, the capillaries impelling their contents of blood and lymph to the interior parts. The cutaneous exhalation is suspended, whilst absorption is supposed to be increased and the papillæ are elevated, producing that kind of roughness of the surface popularly termed goose-flesh. The sudden determination of the blood, and other circulating fluids to the interior, doubtless explains the cause of that embarrassment experienced in the functions of the viscera, more especially of the heart and lungs. Sometimes the pulse is so contracted and slow as to be almost imperceptible. The respiratory movements are performed with difficulty and irregularity, the inspirations and expirations being short, hurried, panting, and broken, as in sighing or shuddering. With infants these effects, together with the terror and restraint to which they are subjected, sometimes make it necessary to suspend the affusions sooner than would otherwise be desirable.

After the affusion, the system gradually recovers from its perturbation, the skin relaxing, and becoming soft, smooth, and moist, the organic movements resuming their regularity, the warmth returning, the pulse becoming less contracted, and more full. These phenomena vary singularly, according to the number, duration, and intensity of the applications, nature of the disease, and constitution and habits of the patient.

As already observed, the water employed is usually about 56° or 66° of Fah. But this is not a positively established temperature, and may be varied to suit circumstances. It is sometimes necessary to use water of still greater coldness, whilst at others it will be requisite to raise the temperature, if the patient be either too feeble or too susceptible. Under these last mentioned conditions, it may perhaps be advisable to commence the affusions with tepid water, or water with its chilliness taken off.

The duration of affusions can only be determined by the effects produced, the intensity of the disease, or the force of reaction with which the patient may be endowed. Sometimes eight or ten affusions will suffice, whilst at others twenty or thirty will be found necessary, and it may even be requisite to recur to them again. The intervals between the affusions should be very short, in order to prevent or keep down reaction.

From the immediate effects produced by cold affusions, they are evidently to be regarded as a perturbating agent of great energy, requiring much discrimination and sound judgment to regulate its application. Judiciously employed, they will almost always be found to produce a notable diminution of the heat of the body, a reduction of the pulse, and what must often be regarded as a great advantage, these sedative effects will not be attended by the debility which follows a recourse to blood-letting. With some feeble constitutions, their use may occasion too much weakness; and should the chilliness continue without any reaction, it will be necessary to dispense with them entirely, and resort to means of internal and external excitement. The application of affusions, to be salutary,

should always leave the patient with a sense of greater strength and general comfort than he had previous to their use. When, on the contrary, their employment is not indicated, the patient will recover his warmth with difficulty, and remain oppressed, restless, and feeble.

The writings of HIPPOCRATES, wherein frequent mention is made of cold affusions, show that the Greeks in his day, and perhaps long before, were acquainted with their curative properties. It would appear that they were chiefly employed in the treatment of causus or ardent bilious fever, typhus causodes, tetanus, gout, rheumatism, cerebral affections, and, in general, all diseases accompanied with acute pains.

The Roman authors scarcely mention affusions; still it is known that they made great use of baths. The Arabian writers are equally silent upon the subject; and through the middle ages they would appear to have been almost lost sight of as a curative resource.

In the commencement of the eighteenth century, when every species of knowledge began to improve, the curative virtues of affusions were again recognized as applicable to several diseases. KŒMPFER, in 1712, witnessed their successful employment for the cure of measles, by the physicians of Java. After this, various writers testified to their excellent effects in the treatment of many acute diseases, both epidemic and contagious. Among these were, HAHN, in 1737—SAMŒLOWITZ, in 1777—WRIGHT, in 1780—VALENTINE, in 1785—CURRIE, in 1798—GIANNINI, in 1802—&c.: so that before the close of the century mentioned, and beginning of the present, they were universally admitted as most valuable therapeutic agents. The late Dr. CURRIE, of Liverpool, is to be regarded as the chief English authority upon the subject of affusions, and if not the first to introduce them into practice in his country and elsewhere, is perhaps to be considered as mainly instrumental in making their utility more extensively known, and pointing out the precise diseases and conditions under which they may be employed with most advantage. We shall therefore give a concise account of his practice, which appears to have been founded upon much experience and close observation; referring, for more minute details, to his "Medical Reports," published in 1798 and 1804.

The fevers in which affusions were chiefly employed by Dr. CURRIE, were of the kinds commonly designated low typhus and nervous. The time preferred for applying them was the period of exacerbation, one of which at least occurs every day, generally in the afternoon, being indicated by increased thirst, restlessness, flushing and internal heat. The height of the fit was considered the best and safest time, when no sense of chilliness was present, and the heat of the surface was steadily above the natural temperature, there being neither general nor profuse perspiration. Dr. CURRIE appears to have erred by omitting a caution in respect to the complication of other diseases with continued fever; such, for example, as that of pneumonic inflammation, or other dangerous affections of the lungs, to which cold affusion must be deemed inadmissible.

The usual effect of cold affusions, as employed by Dr. CURRIE, was to lower the temperature of the body from 2° to 6° Fah., and lessen the pulse from two to twenty beats per minute, and sometimes even more. Where the application of cold affusions has produced effects unusually severe, a cautious use of warm cordial drinks, in small quantities, is recommended; together with frictions to the extremities, and warm applications, such as a bladder of hot water, to the pit of the stomach. In cases favourable to the practice, the fever was sometimes subdued by one affusion, administered on the first or second day of the disease. Each application generally removed the symptoms for the time being, and a few repetitions, on successive returns of the paroxysms, in two or three days terminated the disease. "Though I have used," says Dr. CURRIE, "the cold affusion in some instances so late as the twelfth or fourteenth day of contagious fever, with safety and success, yet it can only be employed at this advanced period in the instances in which the heat keeps up steadily above the natural standard, and the respiration continues free. In such cases, I have seen it appease agitation and restlessness, dissipate delirium, and, as it were, snatch the patient from impending dissolution. But it is in the *early stages* of fever (let me again repeat), that it is always to be employed, if possible; and where, without any regard to the heat of the patient, it is had recourse to in the last stage of fever, after every other remedy has failed, and the case appears desperate (of which I have heard several instances), can it appear surprising that the issue should sometimes be unfavourable?"

In the advanced periods of disease, Dr. CURRIE generally preferred the use of

water only 15° or 20° below the natural heat of the body. After the eighth or ninth day, he often simply sponged the whole body with tepid vinegar, to which he sometimes added water. But where the heat remained considerable, he still persisted in the use of cold affusion.

In intermittent fevers, where the patients were vigorous, affusions applied *before* the period of the *cold* fit, often succeeded in preventing the paroxysm entirely. Where weakness presented an obstacle to this practice, the cold fit was allowed to pass, and the affusion applied during the hot stage, when thoroughly formed; the effect was generally to produce a solution of the paroxysm for the time being, and four or five repetitions finally removed the disease. Dr. Currie was not deterred from the use of cold affusions by the presence of eruptive diseases, or even by ptyalism from mercurials, provided the proper restrictions were attended to. In small-pox, he employed them successfully, regulating their employment by the heat, and other criteria; provided the patient's *sensations* of heat were confirmed by the thermometer. In the *confluent* form, he was doubtful of the utility of this application. A medical friend of his reported to him, that he had employed them advantageously in the commencement of scarlatina, in which disease they arrested the eruption and soreness of the throat.

The French physicians have, in general, opposed the use of cold affusions in eruptive fevers. M. Jolly observes, that instead of their proving useful in scarlatina and measles, he regards the remedy as rarely necessary, little to be relied upon, and even very hazardous, inasmuch as it may subject the patient to dangerous repercussion. When, therefore, the eruption is backward, he greatly prefers *warm* affusions, or baths of short duration, the temperature of which is gradually increased, or which are rendered more exciting by the addition of some stimulating article, such as flour of mustard, the acetic and hydrochloric acids, &c. He in fact only admits of the application of cold affusion in these diseases, where there is a complication of inflammation of the brain and its meninges, on which occasions they should be restricted to the head alone.

Although the French practitioners manifest more tardiness in the employment of cold affusion as a therapeutic agent, than those of the other parts of the European continent, or those of England or America, still they would appear, according to our view of the subject, to have put forth the most rational explanations of their modus operandi, in regard to which various opinions have been maintained. Some, for example, have thought that their chief effect was to promote a salutary reaction. Others, that they operated upon the nervous system as a *perturbating* agent. Others, again, regarded them as the most decided *contra-stimulants.* M. Jolly, most of whose views upon the subject we are inclined to adopt, does not consider either of the foregoing opinions as exclusively correct. He thinks their operation is, in all respects, assimilated to the refrigerating applications, being like them a means of sedation or repercussion when prolonged, and of stimulation when applied only instantaneously. All the difference in the effects arises from the fact, that the affusion being extended over a larger surface, produces more decided and intense impressions than the mere local applications of cold.

Affusions, like all other cold applications, when employed at the commencement of inflammation, will prevent the perception of pain by the brain, and consequently all reaction on the part of this organ, thus arresting in its development the morbid process which tends to produce inflammation. This is upon the principle that inflammation has its seat in the capillary vessels over which the heart exerts but a feeble action, but upon which the nervous system, on the contrary, exercises the most powerful influence; insomuch that it is considered that inflammation always owes its primary origin or development to the action or agency of the nervous system. From this view it is inferred, that to put a stop to the pain and nervous irritation, constituting the primary condition and inseparable element of inflammation, is to stop this in its birth. Affusions may, therefore, according to M. Jolly, be regarded as acting by *direct sedation*, as when continued or kept up for a longer period than common. Stopping short of this, their effect is to provoke consecutive *reaction*, or general or local excitement. M. Jolly thinks that they should never be employed with this intention, but solely for the purpose, and as a means of producing direct *sedation.* He says, that he has several times succeeded in arresting, with cold affusions upon the head, the phenomena of pain in neuralgias, burns, and other painful affections, the seats of which were more or less distant from the cerebral centre. This has led him to propose them as a means calculated to relieve those pains felt after amputation, as if in the limb separated. "I am persuaded,"

says he, "that every local application of cold, as well as every narcotic agent employed upon a painful part, only exercises a sedative effect through either a direct or indirect influence upon the brain; so that it appears to me a matter of indifference to employ sedatives, refrigerants, or opiates, either upon the direct centre of sensibility, or upon the seat of pain, wheresoever this may be, if the parts be not denuded so as to afford an absorbing surface to the narcotic medicine." These theoretical views are in conformity to the practice pursued by almost all authors who have treated upon cold affusions, the application of which they recommend to be made either at the moment of exacerbation, or at the first onset of inflammatory disorders: that is to say, according to the reasoning of M. Jolly, "whilst the affection consists merely in a nervous irritation." Employed later than this, affusions must prove either useless, or more or less hurtful. It must also be observed, that according to the writer last mentioned, the state of calmness and sedation which usually follows the employment of this remedy, may be only transient, in which case it will be necessary to recur to the operation until the force of reaction, that tends to re-establish itself after each instantaneous application of cold is fully overcome. The proper duration of the affusions is, with M. Jolly, the most important consideration in their employment, as exerting the greatest influence over the results to be obtained.

Local affusions produce effects much less strongly marked, unless when applied to parts endowed with extreme sensibility, such as the abdomen and thorax. But these applications are seldom resorted to in affections of the abdominal cavity, and would perhaps prove dangerous in those of the thorax. It is, above all, in affections of the cerebro-spinal system, that affusions, applied to the head and track of the spinal marrow, have been employed with the most striking advantages.

We have already referred to the chief diseases in which they were resorted to by the father of medicine, who also reports, that by their use, he had facilitated the reduction of strangulated hernias; several modern surgeons attest their utility in such cases, in which their good effects are doubtless occasioned by the contractions they excite in the superficial muscles. Some authors speak of their relieving what are called nervous colics. Hippocrates, in his 5th Book of Epidemics, gives the case of a lady, who laboured under intestinal pains of such violence as to endanger her life, and who was promptly relieved by thirty affusions administered over the whole body. Dr. Bird, of Rees, in Saxony, testifies to having employed them with success in cases of nervous rheumatism, (or as the French writers term them, *néuralgies externes.*) They were applied at the height of the paroxysm, and M. Jolly adds his testimony to their utility in such cases, observing, however, that although the applications are incontestably capable of allaying promptly the pains which characterize the paroxysms of neuralgia, they appear little calculated to prevent their return. In Russia, it is said, that cold affusions are so commonly resorted to, that nearly all acute diseases are in their commencement treated by them.

Cases have been recorded by Wray, Copland, Jackson, Wedekind, and others, in which affusions have been employed with advantage in instances where persons had been poisoned by preparations of opium. Their effect, in these cases, was probably to prevent congestion and cerebral hæmorrhage, the same, in fact, upon which their utility rests in obviating the danger from drunkenness, and all determinations of blood to the brain.

In the cases of puerperal peritonitis, reported as having been successfully treated by cold affusions, the trials were chiefly made by English practitioners. It is one of the characteristics of puerperal fever, that patients, labouring under it, seek relief from cold substances, both as drinks and external applications, warm ones being insupportable. From analogy, therefore, cold affusions might be rationally inferred to be useful. But experience would seem rather in favour of the application of cold in a more simple form. The use of cold affusions in arresting uterine hæmorrhage, is amply attested by numerous reports of successful cases.

Cold affusion has been employed with signal success, in the resuscitation of persons thrown into a state of asphyxia, by exposure to deleterious gases in wells, pits, mines, &c., in the asphyxia of new-born children, and also in cases of suspended animation from the effects of lightning. Some authors have recommended them in several affections to which their utility is, to say the least, equivocal. Such are the gout, notwithstanding the authority of Hippocrates, rheumatism, (Tissot,) croup, (Hardes and Baumbach,) tetanus, &c.

Affusions are contra-indicated, as more or less hazardous, in persons of a naturally feeble constitution, and in whom reaction

takes place with difficulty. Also with the plethoric, and such as are predisposed to apoplexy, or some internal congestion. They are also injurious in most chronic affections, in those acute diseases where an internal organ is the seat of inflammation, in aneurismal and even in catarrhal affections.

The more particular indications for the use of affusions, in each disease, will be noticed in the articles on those diseases; all that was proposed in the present article was to point out the mode of employing the remedy, its effects, and to indicate in a general way the principal affections in which it is employed. G. Emerson.

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I. H.

AFTER-BIRTH. The placenta and membranes of the ovum are thus denominated. I. H.

AFTER-PAINS. After delivery, the alternate contractions of the uterus are renewed, and are called after-pains—or the pains which succeed to the expulsion of the contents of the uterus.

These pains arise, most probably, from the presence of coagula, after the placenta is separated and expelled from the uterine cavity. The surface from which the placenta has been separated, has innumerable vessels terminating on it, all of which pour out more or less blood, until the uterus contracts with so much force as to prevent farther bleeding. But, until this is effected, coagula form, and being foreign bodies, provoke anew the contraction of the uterus,

—for, from the exertions this organ has been forced to make, its irritability appears to be increased, and this in most cases to a very considerable degree, and especially in women who have borne several children. This rule, however, is not constant; as we have seen a number of cases, where after-pains never followed delivery, though the patients have had several, or even many children. In these instances, however, it must be remarked, that the *tonic contraction* of the uterus was always sure to follow quickly the expulsion of the placenta, and thus prevent the formation of coagula. Women who have very rapid and easy labours, are more obnoxious to after-pains than those who have more tedious and painful labours. This is owing to the sudden state of vacuity in which the uterus is left, which thus impairs the force of the tonic contraction; and consequently increases the liability to the formation of coagula. After-pains rarely follow a first labour, owing, doubtless, to the tonic power of the uterus being more perfect, under favourable circumstances, with a first, than with subsequent labours—for, the irritability of the uterus appears to be increased by every additional labour; hence the certainty of the occurrence of after-pains, after almost every labour except the first, and their nearly uniform increase in intensity after each subsequent labour.

It would seem, that whatever stimulates the uterus suddenly, without increasing its tonic power at the same time, will provoke its painful or alternate contractions; and this is frequently done even by a sympathetic influence, as by the application of the child to the breast for the purpose of sucking, or from passions or emotions of the mind; and hence, we may conclude, that it is the irritability of this organ that is exalted, by the previous parturient efforts. For the production, however, of after-pains, it is essential that the tonic power of the uterus be exerted to a certain extent, before the spasmodic or alternate contraction can take place; for if the uterus loses its irritability, so far that the tonic contraction cannot take place, we do not find after-pains; but the converse of this does not hold good; for the more perfectly the tonic power exerts itself, the less is the liability to the spasmodic contraction, or after-pains. Therefore, when after-pains exist, the following conditions of the uterus must obtain: First, the tonic contraction must have taken place to a certain degree; second, the blood thrown out by the vessels exposed by the separation of the placenta, must coagulate within the cavity of the uterus, and there act as foreign bodies, and stimulate this organ to the effort of throwing them off; or, thirdly, its irritability must be so exalted, that irritations in parts remote from the uterus, but with which the uterus sympathizes, may provoke it to painful contraction—in a word, oblige it to continue the parturient effort, after the necessity for such effort has ceased.

After-pains recur, for the most part, more slowly, but not much less regularly, than the previous labour pains, and are attended by efforts equally strong, and sometimes more than equally painful. During this contraction, the uterine globe is found to sink lower in the pelvis; to become much smaller, and harder; and followed by the discharge of fluid blood, or a coagulum of uncertain size. We say, of uncertain size; as this will vary in proportion to the capacity of the uterine cavity, or the state of the os uteri. If the former be pretty large, we shall have coagula form, in an equal proportion; and if the latter be pretty firmly contracted, only the more fluid portions of the blood will escape, and the coagulum remain behind; but if the os uteri be not well contracted, or will easily yield to the efforts of the fundus and body, the coagulum expelled may be large, and followed by the flow of fluid blood recently poured out. It sometimes happens, that the os uteri remains so firmly closed, that the coagula cannot escape; then the woman's sufferings are much increased; the fundus of the uterus rises above the umbilicus, is very sore to the touch, and prevents the woman from lying in any other position but on her back; the pulse becomes excited, and fever and delirium sometimes follow, to the great terror of the inexperienced practitioner. The urine becomes suppressed, and the lochia cease to flow. This case has sometimes been mistaken for puerperal fever.

The efficient cause of after-pains has been altogether mistaken by the ignorant; so much so, indeed, as to induce them to withhold all remedies from the suffering patient. They suppose that there is a definite number of coagula contained within the uterus; which number, they say, must be expelled, before these pains will cease. They therefore deprecate all means calculated to appease these pains; holding it hurtful not to have these coagula thrown off: hence, the woman is doomed to long, severe, and unnecessary suffering, because it is said that "after-pains are wholesome."

The contrary opinion now fortunately prevails; and means are eagerly sought, to control these unnecessary and painful efforts of the uterus; and the patient and

the practitioner may felicitate themselves when the remedial means shall succeed.

As the principal cause of after-pains is the imperfect tonic contraction of the uterus, it follows that whatever secures this in the most certain manner, will tend to diminish, if not prevent, the occurrence of this affection. To this end, a proper management of the labour will very much contribute. We would say, that this consisted, first—in not officiously interfering with the natural progress of this process, by attempting to dilate the os uteri when rigid; by abstaining from the administration of stimulating food, drinks, or medicines, and from the unnecessary exhibition of ergot, or of laudanum. Secondly—by rupturing the membranes when the os uteri is fully dilated, or easily dilatable. Thirdly—by permitting nature to finish the delivery of the body of the child after its head is in the world. Fourthly—by instituting frictions upon the abdomen, over the region of the uterus, before any attempt is made to deliver the placenta. Fifthly—by not using force to relieve the uterus of the after-birth. Sixthly—by again recurring to frictions upon the abdomen, after the discharge of the placenta. If this plan be followed, the tonic contraction will be much increased in power; and, in the same degree, will the severity of after-pains be abated, though not always overcome.

Therefore, should they occur under the ordinary form of mere uterine contraction, camphor or opium, or both, should be resorted to, as soon as they appear. Camphor is equally, if not even more certain, to overcome the morbid irritability of the uterus, than opium. It should be given in powder, or in the form of julep, in ten-grain doses, repeated every half hour, hour, or two hours, as necessity may require. If in powder, the following mode of exhibition answers perfectly well. ℞. Camphor. ℈ij.; Alcohol. gutt. x.; f. pulv. div. in Chart. iv. These powders are to be mixed in syrup or mucilage of any kind, and given as just suggested. If the form of julep be preferred, the following is a neat one. ℞. Camphor. ʒij.; Alcohol. q. s. f. pulv. adde; Pulv. G. Arab. ʒij.; Sacch. alb. q. s.; Aquæ puræ. ℥vj.—M. Of this, a table-spoonful may be given every half hour, hour, or two hours, as the necessity may demand.

To opium, there is sometimes a constitutional opposition. When this idiosyncrasy prevails, it is unfortunate, but it is not always insurmountable; for the peculiarity is rather against the drug in its common form, than against its proximate principle. The sulphate of morphia, for instance, in quarter-grain doses, in solution; or the denarcotized laudanum, in forty-drop doses, may be given advantageously, when the other forms cannot be tolerated. Opium, however, is sometimes ineligible in any form, owing to the febrile condition of the system. Camphor, then, merits the preference, when the woman's sufferings demand relief. It is occasionally necessary to premise blood-letting; but this is very rare.

Should coagula be retained, as above noted, no dose of camphor or opium will abate the suffering, until they be expelled. Their expulsion must be solicited by frictions over the region of the uterus, or by the application of moist warmth to the abdomen. A very thick pancake of fried flour and water, between the folds of a napkin, applied to the abdomen, is almost sure to cause the expulsion of these coagula. After they are forced off, if pain continue, it should be treated as above suggested.

There is a form of pain, which we can scarcely look upon as a modification of after-pain, that I have never seen noticed by authors. It is a severe and continuous pain at the extremity of the sacrum and coccyx. It begins the instant the child is expelled, and continues to an indefinite period, with excruciating severity. It is to be overcome by the remedies above suggested, properly persevered in.

After-pains are not always seated in the uterus. We once knew them located in the knee; and once, in the jaw. They yielded to the above treatment.

Many other remedies have been proposed for the relief of after-pains; as, the oil of juniper, sweet oil, and the hydrocianic acid; but the latter article has altogether failed, in our hands.

W. P. Dewees.

AGALACTIA. (From α, priv. and γαλα, milk.) Absence or suppression of the secretion of milk. (See *Suckling*.)

AGARIC. (See *Boletus*.)

AGATHOSMA. (*Botany*.)

Sex. Syst. Pentandria Monogynia.—*Nat. Ord.* Diosmeæ.

Gen. Ch. "*Calyx* five-parted. *Petals* ten, unequal, inserted in the calyx. *Nectary* five-lobed, inserted in the calyx." *Lindley*.

This genus was separated by Willdenow from the *Diosma*. It includes several species, which, as well as those of *Diosma*, are natives of the Cape of Good Hope. The plants belonging to both genera are small shrubs or under-shrubs, and are remarkable for the odorous properties of their leaves, which are employed by the Hottentots to scent the grease with which they rub their

bodies. The generic titles are expressive of the agreeable odour of the plants; both being derived from the Greek word οσμη, smell, to which is prefixed, in one instance, the epithet αγαθος, good, and in the other, διος, divine. The odour, however, is either not equally agreeable in all the species, or produces different impressions upon the organs of different individuals; for THUNBERG found it insupportably offensive in the bodies of the men whom he employed to drive his wagon. It depends on a volatile oil, contained in numerous minute transparent glands with which the leaves are furnished. It is probable that the several species of the two genera are somewhat analogous in medicinal properties; but it is the *Agathosma crenatum* which has attracted most attention, and which has been adopted as officinal, by the Dublin College, under the name of *Diosma crenata*, or *Buchu*. The latter name was derived from the language of the Hottentots, who apply it indiscriminately to the different species which they use as perfumes.

A. crenatum, Willd., *Hort. Berol.*—*Diosma crenata*, Thunberg; Ph. Dub.—*Buchu.*—*Gekerbter Buccostrauch*, Germ. —*Sp. Ch.* "*Leaves* ovate, crenate, dotted beneath. *Flowers* axillary, solitary." *Lindley.*—This is an evergreen shrub, with a stem from one to four or five feet high, the branches of which are scattered, or in whorls, and bears upon short petioles, ovate or lanceolate, crenate, coriaceous leaves, dotted on their under surface. The flowers are white, and stand singly at the axils of the leaves. The fruit is a stellate capsule, containing black shining seeds. The leaves are the part used in medicine. (See *Buchu*.) GEO. B. WOOD.

AGAVE. (*Botany*, and *Mat. Med.*)

Sex. Syst. Hexandria monogynia. *Nat. Ord.* Bromeliaceæ.

Gen. Ch. "*Corolla* superior, six-parted, erect. *Filaments* longer than the corolla. *Anthers* versatile." *Elliot.*

This genus of plants, which is peculiar to America, is closely allied to, and has been often confounded with, *Aloe*. Several of the species are employed in medicine and in the arts, though it is difficult to assign to each their peculiar properties, as many distinct species were confounded, by the earlier writers, under the common name of *A. Americana*. Thus, the *A. Mexicana*, which was separated by LAMARCK, appears to be identical, as respects its physical qualities, with the original species; whilst the *Cubensis* furnishes roots which possess some of the medical virtues of Sarsaparilla.

A. Americana. American aloe. *Agave d'Amerique*, Fr.; *Maguey*, Span. *Sp. Ch.* Stemless. *Leaves* dentate, prickly. *Scape* branching. *Corolla* narrower about the middle. *Stamina* exserted. *Style* longer than the stamens.—*Willdenow.* This plant is a native of many parts of South America, and is employed for a variety of purposes. From the juice, which is furnished in large quantities, at certain seasons of the year, by the leaves, is prepared a honey; but this juice is generally permitted to ferment, when it forms a vinous liquor, known under the name of *Pulque*. From the leaves, which are very fibrous, is made an excellent thread, which was in use among the Mexicans before the arrival of Cortez. ACOSTA terms this plant *Auve de las maravillas*, from the number of uses to which it is applied in the arts. As a medicinal agent, the Agave appears to have been too much neglected, if full credit is to be given to its eulogists. There, however, can be no doubt but that a decoction of its root has proved fully equal to Guaiacum, in the cure of syphilis, and more particularly those cases aggravated by the exhibition of mercurials. It has also been eminently successful in the treatment of scrofula. The fresh juice is also used as an external application to ulcers. The *A. Mexicana*, LAM., is used for all the above purposes, in Mexico.

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R. E. GRIFFITH.

AGENESIA. (From α, priv. and γενεσις, generation.) This epithet, in its most ordinary acceptation, is synonymous with impotence and sterility. (*q. v.*) It has also been employed in modern times, to designate the vices of conformation, consisting in the absence of certain parts and resulting from an arrest of development. (See *Monstrosity.*) I. H.

AGENT. (From *agere*, to act.) That which has the power of acting or of producing effects. This term is exceedingly general in its signification. There are various species of agents; as hygienic, morbific, therapeutic, &c. I. H.

AGES. Ηλικια, Gr.; *Ætas*, Lat.; *Age*, Fr.; *Alter*, *Lebensalter*, Germ.; *Eta*, Ital. (*Phys.*) The term Ages is applied, in physiology, to the several stages through

which the human body passes during its progressive development and subsequent decay, from the period of birth to that of its final dissolution.

The facts connected with the formation and growth of the various organs of the human body in utero, belong to the history of *intra-uterine* life, and will be considered in the article FŒTUS.

Of the various and important mutations which the living organism undergoes between birth and death, every one is aware. By the poet, they have been compared to the successive seasons of the year, and hence the expressions spring-time and summer, and autumn and winter of existence, have become to be among the most familiar in our language.

Upon the physiologist devolves the task of tracing the changes in the condition of the different organs, by which the several ages of life are produced, and of establishing, in relation to each, important general facts for the guidance of the pathologist, the therapeutist, and the medical jurist.

At the moment when the human being emerges from the womb, and enters upon the enjoyment of a separate state of existence, it presents physiological as well as physical characters, which it preserves during a certain period, altogether distinct from those which are proper to it in the subsequent periods of life. All of the organs are imperfectly developed, while many of them are as yet merely rudimental, and the whole of the functions of life are confined almost exclusively to those of nutrition. By degrees, however, the different parts of the system become more perfectly organized—the body increases in size, and exhibits an augmentation of strength and vigour, until finally all the organs acquire that complete development which capacitates them for the active performance of their respective functions. As the organism thus gradually approaches towards maturity, important modifications are presented in its physical characters, as well as in its vital phenomena. The characteristics of infancy are exchanged for those of childhood; these are succeeded in due time by those of youth, and finally the whole system having acquired its entire growth and vigour, and all its functions being brought into full activity, it assumes the characteristics of the adult age. To all appearance, it now remains for a longer or shorter period entirely stationary. But soon symptoms of decay present themselves—organ after organ loses a portion of its energy—its functions are performed less perfectly, and finally cease entirely. The decrepitude of old age creeps on more or less quickly, and the strength and vigour which characterized previously all the phenomena of life, give place to constantly increasing debility and languor. At length some organ, essential to life, ceases to act, and vitality becomes quickly extinguished in every part.

We perceive, therefore, that the distinction of the whole period of human existence into various stages has a real existence, being founded upon those laws by which the growth and decline of the organism are governed. Each of the principal organs of the system becoming in its turn developed, and its functions added, as it were, to those already in existence, as it arrives with more or less rapidity towards its maximum of vitality, must necessarily modify the organism, as well by increasing the number and extent of the vital phenomena, as by its enjoying, for a season, a predominance of activity. An equally striking, but different kind of modification is produced, as each organ, after arriving at maturity, loses by degrees its excitability, until it can no longer respond to its appropriate stimuli, and its functions cease.

The several stages of growth, maturity, and decline, differ very considerably in their duration. The development of the organism is at first accomplished with great rapidity, but it becomes gradually more and more slow until the age of maturity is attained; while, on the contrary, the decline of the organism is at first very gradual, but increases in rapidity as the period of dissolution approaches. It is, therefore, during the middle term of existence, that the system undergoes the least change: it even appears then to the careless observer to remain entirely stationary. This, however, is not the case. There is, in fact, no interval—no period of repose in the living body, between the point at which the several organs cease to grow, and that where their decline commences. The moment they have arrived at their full development, is that when their decay commences.

Hence, however striking the difference between the physical and vital phenomena peculiar to the period of infancy, and those of youth, maturity, or old age, there is a very great difficulty in defining accurately the limits by which the contiguous ages are separated from each other. To determine, for example, at what precise period infancy ceases, and childhood commences; what line of separation exists between the latter and the age of adolescence, or be-

tween this and adult life—or when it is that man loses the distinctive characteristics of virility, and assumes those of old age. Each stage glides so gradually and imperceptibly into that which succeeds, as to cause not unfrequently a blending of the phenomena peculiar to both.

The number of years that have elapsed since birth, affords no certain indication of the physiological age. Climate, moral and physical education, diet, regimen, and various other circumstances, produce so powerful an influence either in retarding or accelerating the development of the organism, that the same physiological age will occur in one individual five, six, or seven years sooner or later than in another. Thus the age of puberty, especially in females, is attained in tropical climates at a period of life at which, in colder regions, the individual is still scarcely emerged from infancy. In fact, all those circumstances which influence the duration of existence, either in extending or diminishing it, exert a similar influence upon the duration of each of the physiological ages, and the rapidity of their succession. Thus, in warm climates, the stage of infancy is extremely short, that of puberty is early attained; the period of maturity arrives, and passes with equal rapidity, and the decrepitude of extreme old age is experienced, when, in colder climates, the system is still in the enjoyment of all its vigour. A luxurious life, heating aliments and drinks, an early excitement of the sexual appetite, and the excesses of all kinds, to which certain individuals deliver themselves without restraint, produce a similar effect in accelerating all the stages of life, and shortening the entire duration of existence. On the other hand, in temperate climates, and by a life of temperance and of activity, the several stages of life linger long, and succeed to each other by slow and imperceptible gradations, and the approach of old age and of death is retarded to a very late period. Bebe, the celebrated dwarf of the king of Poland, ran through all the stages of existence, and died in his twenty-third year, with all the marks of extreme old age; while, on the contrary, in Henry Jenkins, of Yorkshire, and Thomas Parr, of Shropshire, England, the period of old age did not arrive until they had lived, in the one instance, an hundred and fifty, and in the other, an hundred and forty years.

Various attempts have been made to distinguish the ages by certain physiological characters. Thus, by some writers, life has been divided into the stages, first, of growth; second, of stability; and third, of decay; and by others, into the stage during which the organs of generation are inactive; that in which they are active; and finally, that in which they have ceased to act. Both of these divisions are, however, too general and incomplete to serve as a useful classification of the phenomena of growth at the different epochs of existence. The ages have likewise been divided by physiologists, with greater accuracy, into those of *lactation*, terminating with the eighth month, being the period during which the child is confined solely to the breast; 2dly, that of *dentition*, ending with the seventh year, being the period which elapses between the commencement of the first and that of the second dentition; 3dly, that of *childhood*, ending with the fourteenth year, or commencement of puberty; 4th, that of *puberty*, ending with the twenty-first year, or the completion of the growth of the body; 5th, that of *youth*, ending with the thirtieth year; 6th, that of *maturity*, ending with the fiftieth year; 7th, that of *decline*, ending with the sixtieth year; and 8th, that of *old age*, comprehending the remaining portion of existence. It will be perceived, however, that while important physiological changes distinguish, with tolerable accuracy, the first series of ages here enumerated, the division of the latter series is in a great measure arbitrary, and will differ in almost every individual. We prefer, therefore, to adopt the usual distinction of the ages into those of infancy, childhood, youth, maturity, and old age. A more accurate division might probably be suggested; the foregoing recommends itself, however, by its simplicity, and by its corresponding with that most generally followed by modern physiologists, while it corresponds with the most striking changes that occur in the organism during the progress of life.

The study of the several ages is not only interesting as a branch of general physiology; it is highly important, also, to the physician in a pathological point of view. The condition of the various organs in the different stages of their development; the predominant activity of one or other at certain periods; the state of each during maturity, and the gradual decrease in their energies subsequently, modifies in a very great degree, the character and march of the diseases which occur at the several stages of life. Thus the great size and vascularity of the brain, during infancy, the extreme delicacy and excitability of the skin and mucous membranes,

and the great development of the lymphatic system, render these parts more frequently than any others the seats of disease. Their susceptibility to morbid impressions is increased, during childhood, by the process of dentition, and the increased activity of the digestive and nutritive functions. During both ages, the morbid actions, which occur, very generally assume the subacute form, and in many cases produce extensive disorganization, before any very violent or alarming symptoms are manifested. In youth, diseases assume a more intense and acute character. While the alimentary canal and brain are equally liable to be their seat, the skin and lymphatic system are more seldom affected than in infancy and childhood. During the age of adolescence, the sanguineous system of red blood predominates, giving rise readily to acute hæmorrhages, and violent inflammations of those organs in which the red capillaries abound. During the period of maturity, the entire organism having arrived at its greatest degree of perfection, and the action of each part being in harmony with that of the rest, a greater resistance is presented to the influence of morbific causes than at any other period of life; hence the diseases of this age are, generally speaking, fewer and more simple in their character, unless, as is more commonly the case, from irregularities in the nutritive functions, during the preceding ages, or from undue and long-continued excitement of particular parts, one or more organs have acquired a morbid development and predominant activity, in which case they will readily become the seat of disease. As the period of old age creeps on, the balance between the energy of the several organs being, to a greater or less extent, broken up, and the vitality of each being diminished, morbid action is of more ready occurrence than in middle life; it is in general, however, of a less violent and acute character than in youth or mature age. In the decline of life, the sanguineous system of black blood predominates; venous congestions, chronic hæmorrhages, and effusions of serum into the several cavities, are among the more common of the diseases incident to old age.

Not less important is the study of the ages in a therapeutical point of view. During the early periods of life, all violent remedies should be carefully avoided; in a large number of the diseases of infancy and childhood, the most simple means will be found the safest and most effectual. Abstinence, bland diluents, bathing, general or local, the application of leeches and mild revulsants, are the remedies that will most generally be sufficient for the removal of the diseases which then occur. As, however, the organism becomes developed, and its vital energies increase, its diseases assume a greater degree of intensity, and demand a more active treatment for their removal. While, during the decline of life, at the same time that the remedies are adapted in power to the violence of the morbid action, care should be observed to spare, as much as possible, the enfeebled energies of the system; recollecting, that at this period of life, all violent impressions are sustained with difficulty, reaction taking place but feebly and imperfectly, and the recuperative powers of the system being much less active than at any former age.

A knowledge of the condition of the several organs during the different stages of existence, is finally indispensable to the medical jurist, to assist him in determining many nice and important points in cases of presumed infanticide, in questions of identity, and in certain cases of murder, &c.

§ I. Infancy. *Infantia à non fando*, Lat.; because of the inability to talk; νηπιότης, Gr.; *Enfance*, Fr.; *Kindheit*, Germ.; *Infanzia*, Ital. The age of infancy extends, agreeably to the division we have adopted, from birth to the commencement of the second dentition, or, generally speaking, until about the seventh year. According to M. Halle, this period of life includes three distinct physiological epochs. The *first* extending from birth to the commencement of the first dentition; the *second*, comprehending the period occupied in the process of dentition; and the *third*, extending to the appearance of the permanent teeth.

a. Organization. At birth, the entire organism is but imperfectly developed. The body measures from seventeen to twenty-one inches in length, and in weight varies, agreeably to the repeated observations of Professor Chaussier, from six to nine pounds. The skin is of an extreme delicacy, and of a deep red colour. It is, also, more vascular, and more freely supplied with nerves than in after-life. After a few weeks, however, it loses its deep red tint, changing by degrees to a dirty yellow, and finally assuming a degree of whiteness which it seldom retains in after-life. But during the whole period of infancy, it exhibits great irritability, and is very liberally supplied with blood. The head and abdomen of the young infant are of a bulk disproportionately large, com-

pared with that of the rest of the body. The pelvis is small and contracted, and the inferior limbs have a much less degree of development than the superior; several months, indeed, elapse, before the latter acquire a size proportionate to that of the other parts. The muscles are at first soft, pale, and gelatinous; they contain but a small amount of fibrine, and, in common with all the soft parts, are destitute of firmness. All the tissues abound in lymph, and the lymphatic vessels and glands have a development and activity far superior to what they possess in after-life. The limbs of the infant are round, smooth, and plump, as well as all the prominent parts on the exterior of the body. This arises from the large amount of fat, and soft cellular tissue filled with serum, which is interposed between the skin and muscles. As infancy advances, the fat diminishes, and the cellular tissue becomes more dense, while the exhalation into its cells is lessened; the outlines of the muscles are, in consequence, rendered more apparent, and the form of the limbs and trunk, especially in males, is somewhat changed. In the early period of infancy, the bones are still in a great measure cartilaginous; the central cavity of the long bones can scarcely be said to exist, and the sinuses in those of the head are not at all, or but imperfectly, developed.

The digestive canal is of very considerable size: the liver has a bulk greatly disproportionate to the residue of the abdominal organs, but the gall bladder is small, and the portal veins and the spleen are but little developed. The omentum is peculiarly delicate, and almost entirely devoid of fat. The pancreas and kidneys are large, while the urinary bladder is small, having a more elongated shape than in the adult, and is placed rather above, instead of within the pelvis. The size of the renal capsules is much greater than in after-life.

The lungs, which in the fœtus were small, dense, and of a brownish colour, expand immediately after birth to double their former bulk, and become soft, crepitant, and of a rosy hue. Though of less specific gravity than in the fœtal state, in consequence of the air which pervades their cells, yet their absolute weight, from the greater amount of blood transmitted to them, is doubled. The ventricles of the heart, and the principal arterial trunks, are of considerable size, while the auricles, and large venous trunks, have a much less development.

The organs of the external senses, with the exception of that of smelling, are fully formed in the infant, and the nerves distributed to them are large. The nose is small, and the nasal fossæ are either wanting, or imperfectly developed. The larynx is very small, both in depth and diameter, and presents no protuberance at the anterior part of the neck. The thymus gland, which, in after-life, almost entirely disappears, is now of considerable size.

During infancy, the brain is large in size, but of a soft and almost fluid consistency; the same is also true of the spinal marrow, and of the cerebral and ganglionic nerves. The genital organs of both sexes, though fully formed in the infant, are but little developed; the clitoris and nymphæ of the female are often, however, disproportionately large in comparison with the other parts.

Until the termination of the first period of infancy, the general organization and appearance of the body undergo but little change. The infant, however, gradually increases in size and weight. The head, though still voluminous, diminishes in the relative size it bears to the rest of the body; while the pelvis expands, and the inferior extremities become longer, and more fully developed. The softness of the tissues diminishes gradually, and they acquire a greater degree of density. The fat and serosity become reduced in quantity, and although the temperament is still decidedly lymphatic, the predominance of the white fluids over the blood diminishes, as the termination of infancy approaches. The bones lose, by degrees, their cartilaginous form, by the constant increase of ossification. The central cavities of the long bones, and the sinuses and other cavities of those of the face and head, become more fully developed. The articulations acquire greater firmness, and those of the extremities augment in bulk. The jaws become more expanded; and about the sixth or seventh month, the first teeth make their appearance, and by the end of the second year, when the first dentition is completed, each jaw contains ten. These teeth, which have received the popular denomination of milk-teeth, are retained until about the seventh year, when the second dentition commences, and the permanent teeth successively make their appearance, to the number of twenty-eight.

As the termination of infancy approaches, the larynx augments in size; the muscles lose, by degrees, their gelatinous character, become more fibrinous, and acquire more and more of the deep red colour which distinguishes them in after-life.

During the entire period of infancy, the

digestive and nutritive organs maintain their predominance. The lungs gradually develop themselves, but still preserve their great vascularity, the smallness of their cells, and a degree of density superior to that which they acquire in the subsequent ages. The heart and blood-vessels undergo but little change until towards the termination of infancy. The disproportion in the size of the liver, especially of its middle lobe, decreases gradually. The gall-bladder augments in capacity, and the urinary bladder assumes more of an ovoid form, and sinks lower into the pelvis.

The organs of hearing, of sight, and of taste, undergo but little change during this age. The cavities of the nose, as well as of the mouth, however, become more developed, and the sense of smelling, and probably that of taste, more acute and discriminating.

The disproportionate size of the brain diminishes; it increases in consistency, its convolutions become more apparent, its colour less red, and the proportion of its medullary matter is increased. The same is true of the medulla spinalis, and of the nerves. The organs of generation undergo but little, if any change, until towards the age of puberty.

b. Functions. Immediately after birth, the function of respiration commences. The lungs and chest dilate, and the external air rushes into, and distends the pulmonary cells; while the closure of the communication which in the fœtus exists between the two auricles of the heart; the obliteration of the umbilical vessels, and of the arterial and venous canals, cause the whole of the blood received by the right side of the heart, to pass through the lungs, and there to become arterialized by its contact with the atmospheric air. From this period, the arterial and venous blood circulate, each in its distinct set of vessels. Respiration, once established, continues without interruption, as in the adult; it is however more frequent, and is accomplished almost entirely by the action of the intercostal muscles. Examined by the stethoscope, it is found to be louder, also, than in after-life, as though the bronchial ramifications experienced a greater degree of dilatation, and received a proportionately greater amount of air. The circulation, which is accomplished in the same manner as in the adult, is much quicker and more rapid. The pulse of the infant is in consequence more quick and frequent, beating one hundred strokes and upwards in a minute. It gradually, however, decreases in frequency with the approach of childhood.

Soon after birth digestion commences, and during the entire period of infancy is peculiarly active, demanding an almost constant supply of the food furnished by nature in the breast-milk of the mother. This food, which is the only kind adapted to the peculiar condition of the digestive organs in the earlier months of existence, increasing in consistency as the energies of the stomach become more developed, is fully adequate for the support of the system, until the commencement of the first dentition, when a more substantial aliment would seem to be required. The appearance of the teeth, the augmented size of the salivary glands, and the increased bulk and strength of the muscles subservient to mastication, enable the infant, after the first year, to partake of solid food, which the stomach then digests with facility.

The whole of the functions concerned in the nutrition of the system, are equally active with those of digestion. The process of assimilation predominates considerably over that of decomposition, as is evinced by the constant growth of the body, and the rapid development of certain organs. The discharges from the bowels are frequent, and passed almost involuntarily. In the earlier periods of infancy, they differ from those in after-life, by their lighter colour, their curdy appearance, and by the absence of any decided fetor. After the first year, they become less frequent, darker coloured, and exhale a stronger odour. They are then, also, more under the command of the will. The urinary secretion is in full activity at birth, but the urine is at first pale and watery, and scarcely contains any of those peculiar principles which distinguish it in after-life. The benzoic acid exists in a larger amount, generally, in the urine of infants, than in that of adults. The exhalant function of the skin is extremely active during this age, and from this circumstance, and the great excitability of the dermoid tissue, it is readily augmented by a slight stimulation, and as readily checked by a trifling diminution of temperature. Calorification is at first feeble, the heat of the body in young infants being, according to the investigations of Edwards, several degrees less than in the subsequent periods of life. For several months after birth, the infant suffers severely from the influence of a cold atmosphere, and the proper temperature of its surface can be maintained only by sufficient clothing, and other artificial means. By degrees, however, the process of calori-

fication acquires a greater degree of energy, and the body becomes less sensible to the influence of atmospherical vicissitudes.

The functions of relation commence at birth, and are rapidly developed during infancy, but do not attain their utmost perfection until a subsequent age. The moment the infant emerges from the womb, it commences to cry, and to move its body and its limbs in different directions. If the breast be now presented to it, it will seize upon the nipple and instinctively perform the complicated movements of the mouth, lips, and tongue, required in the act of sucking. It is difficult to decide upon the actual cause which prompts the first cries of the infant, and the agitation into which its limbs are thrown. They would appear, however, to be occasioned by the uneasy sensations to which the sudden entrance upon a new state of existence gives rise.

During the first weeks of life, the external senses are but slightly developed; the infant is nevertheless sensible to the impression of cold, and experiences pain when the skin is irritated or wounded: very soon, however, the existence of the sense of touch is manifested. The sense of taste is, also, exercised very early; that of smell, however, is but imperfectly developed until a later period, in consequence of the incomplete state of the nasal cavities, and the limited extent of the Schneiderian membrane. It is not until about the fifth or sixth week that any indication is presented of the exercise of sight or hearing; but subsequently to this period they speedily acquire their full development. Hunger, thirst, and the instinctive desire for the constant admission of fresh air into the lungs, are among the internal sensations which are first experienced: they have, during infancy, the same general characters which they exhibit in after life. Those sensations which prompt to the exercise of the voluntary muscles, and probably those connected with the evacuation of the contents of the bowels and bladder, are experienced at a very early period. As infancy advances, the first of these sensations are more intense, perhaps, than in the after stages of existence. So soon, indeed, as the muscles become sufficiently developed, and the locomotive organs generally have acquired adequate strength and vigour, the infant, during its waking hours, is in almost constant motion; while in health, a state of inaction, for a single instant, would appear indeed to be to it one of actual suffering.

At birth, and for several months subsequently, the imperfect ossification of the bones, the disproportionate size of the head, the smallness and obliquity of the pelvis, the laxity of the articulations, and the imperfect development of the muscles, render the erect posture and progression impossible. By degrees, however, the inferior extremities acquire an augmented size, the bones become more solid, the articulations firmer, the spinal column better adapted to sustain the weight of the body; while, at the same time, the muscles increase in bulk and in strength. The infant is now enabled to sit upright and to creep about on all fours, and by the end of the first year assumes the erect posture and is able to walk. From this period, all the movements of the body become daily more firm, prompt, and active; and from the very great suppleness of the entire frame, the child pursues with ease and delight all those muscular exercises which require facility and quickness of motion rather than strength or skill.

During the first weeks of existence, the intellectual and moral faculties are entirely wanting. The whole external world appears, in a certain sense, to be, as it were, shut out from the infant. Unconscious of existence, it awakes merely to satisfy the instinctive calls for food, and when these are appeased, falls again into a state of repose. A state of sleep would seem, indeed, to be that which is the most natural to it at this period. The little being is only wakeful and restless when suffering from pain, hunger, thirst, or other uneasy sensations. But, by degrees, as the brain becomes more perfectly organized, and sensibility is rendered more acute and discriminating, the infant exhibits greater intelligence; its eye takes cognizance of the objects by which it is surrounded, and distinguishes them from each other; its ear also becomes sensible to sounds. It commences now to know its parents or its nurse, and to distinguish them from the other individuals of the family, and from strangers. It manifests desires and will; it experiences affection, aversion, anger, joy, and grief; it becomes capable of laughter and of genuine tears: about the end of the first year, sometimes sooner, it attempts the pronunciation of words, and very soon the infant is possessed of speech. Its pronunciation is at first very defective, and from the imperfect state of many of the organs of speech, the tones of the infantile voice are weak, shrill, and deficient in modulation; nor do they attain to their full perfection until some time after puberty.

At the end of the first year, less time is passed in sleep. Nevertheless, the constant exercise to which the waking hours are devoted, renders it still longer than in the subsequent ages; while the repose is much more perfect and profound. At this period, the intervals of sleep are very irregular: whenever the senses or the muscles become fatigued, slumber immediately ensues; but as the age of infancy advances, and the period of wakefulness is prolonged, sleep occurs only at regular periods, and most generally during the night.

From the end of the first year to the termination of infancy, the development of the intellectual faculties proceeds regularly. The senses rapidly acquire their utmost degree of activity, and the perceptions become prompt and rapid. The memory has at this period a very great activity and extent—enabling the infant not only to treasure up the ideas excited by the physical and other properties of the thousand objects which surround him, but the words also, or the names which have been affixed to them, as well as those by which the various sensations and wants which he himself experiences, are expressed. A knowledge of the prominent qualities of external objects, and of language, is, in fact, acquired almost exclusively during infancy and childhood. While the faculties of observation and retention are thus active, those of comparison, reflection, judgment, and of reasoning, are in a great measure absent. It is by instinct, or from present sensations only, that an infant appears to judge and to reason: hence the numerous errors into which he constantly falls, and the necessity of giving, by a proper education, a correct and useful direction to his ideas. From the want of reflection, judgment, and experience, the infant is credulous, docile, and ingenuous—he is pleased with trifles, and lives, as it were, for the present moment only.

All the affective faculties, if we except those connected with the reproductive instinct, manifest themselves in a striking manner during the latter periods of infancy, and give rise to their appropriate expressions and gestures. Thus the young being exhibits the feelings of attachment and aversion, of anger, vanity, jealousy, pride, and shame; and the frequent and unrestrained indulgence of one or other of these passions, unless a judicious moral culture is early commenced, causes it to obtain a predominance which will materially affect the character and happiness of the individual in after life.

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c. Pathology. The delicacy of the skin during the earlier stages of infancy, its extreme irritability, and very great vascularity, render its several tissues peculiarly liable to disease of various grades, from the simplest rash to the most violent inflammation terminating rapidly in extensive disorganization; and from the action of causes which, in the adult, would scarcely produce any morbid effect. Infancy is, in fact, the age when eruptive complaints most commonly prevail: thus, in casting our eye over the list of cutaneous affections, it will be found that the great majority of them, especially of the more acute varieties, are more liable to occur during the infantile age, than at any other period.

The mucous membranes also present, at this age, the same delicacy of structure, and the same predominance of vascularity and irritability, as the skin; consequently, different degrees of irritation or of inflammation are readily excited in them. Bronchitis, pneumonia, and croup, destroy, in fact, a large number of infants. But it is the gastro-enteric mucous membrane that is the chief seat of disease in infancy. A slight excess of food, or that which is too stimulating, or unadapted to the state of the digestive organs at this period of life—a trifling reduction of the temperature of the skin, personal impurities, or any degree of impurity in the atmosphere, will in general give rise to colic, vomiting and purging, aphthæ, tympanitic distensions of the abdomen, and the other phenomena of acute or chronic inflammation of the stomach and bowels. Softening and perforation of the stomach, constituting the disease to which the denomination *Gastro-malacia* has been applied by the German writers, most frequently occurs during infancy. The inflammation, in many instances, extends from the stomach to the mesenteric glands, occasioning their enlargement and disorganization, attended with enormous distension of the abdomen, and extreme emaciation of the body, either in consequence of the defective digestion of the food, or the impediment to the free passage of the chyle through the diseased glands. Inflammation frequently extends also from the digestive mucous membrane to the peritoneum: it here generally assumes a very chronic form, and sooner or later causes an effusion of serum into the cavity of the abdomen.

During infancy, the large size of the brain, the delicacy of its structure, its extreme vascularity, and the activity with

which the nutritive process is there carried on, render it extremely liable to disease from morbid impressions made directly upon it, or by irritations transmitted to it from other parts. Hence, spasms, convulsions, deep comatose sleep, inflammation of the brain or its membranes, terminating in serous effusion within its ventricles, are among the most frequent diseases of infancy. Few cases of extensive or long continued irritation of the alimentary canal occur at this age without producing more or less disease of the brain.

The extreme development and activity of the whole lymphatic system during infancy, causes it to become readily the centre of irritation, giving rise to enlargement, inflammation and suppuration of the lymphatic glands, a tuberculous condition of the lungs and other organs, serous infiltrations of the cellular tissue, and the various other symptoms of scrofulous disease.

From a variety of morbific causes, but more especially from deficient food, or that which is of a bad quality, from an impure atmosphere, deficient exercise, or the action of cold and moisture, nutrition is often rendered imperfect during infancy, or by the undue excitement of one or more organs, becomes excessive in one part, while it is deficient in another. In consequence, the growth of the body generally is impeded, or one portion is morbidly developed at the expense of the others. In all such cases, the limbs remain small, the muscles soft, flaccid, and deficient in energy, the skin assumes a pale or a dirty yellow appearance, the articulations become enlarged, and the bones soft, so as to be readily bent and distorted by the action of the muscles or by the weight of the body.

Worms in the bowels are usually ranked among the most usual causes of the complaints of infancy. That their presence may give rise to a morbid degree of irritation in the gastro-enteric mucous membrane, and, secondarily, in the brain or lungs, there can be little doubt; nevertheless, in most cases, the symptoms popularly ascribed to worms, are produced by a diseased condition of the alimentary canal, entirely independent of the presence of these animals, and may continue notwithstanding the destruction or removal of the latter.

The first dentition is frequently accused of being the immediate cause of the diseases which occur during the second period of infancy. Dentition, however, cannot, of itself, be considered a disease, during this or the subsequent age; but when a predisposition to morbid action already exists, the process of dentition may become the exciting cause of the most alarming symptoms. The irritation produced in the gums during the progress of the teeth to the surface, almost invariably gives rise to more or less pain or uneasiness, with increase of heat and redness of those parts; and as this irritation generally extends to the gastro-intestinal mucous membrane, some degree of diarrhœa commonly attends the process of dentition. If, from any cause, the stomach or bowels have been previously brought into a state of morbid irritation, excessive vomiting and purging, fever, and other symptoms of more severe disease, will be induced. In other cases, when the process of teething is accomplished with great difficulty, violent inflammation or even sloughing of the gums may occur. More commonly, besides exciting irritation of the stomach and bowels, the increased amount of blood which, during dentition, is determined to the vessels of the head and face, increases the tendency to disease in those parts; hence, convulsions, ophthalmia, inflammation of the glands of the neck, ulcerations behind the ears, eruptions of the scalp, arachnoiditis, and hydrocephalus, very frequently occur at this period of infancy.

Deformity and disease are often occasioned during infancy, by falls, by improper postures of the body long continued, by improper clothing, and by too early attempts to induce the child to assume the erect posture or to walk.

§ 2. Childhood. (From the Saxon *Cildhad.*) παιδια, Gr.; *pueritia*, Lat.; *puerilite*, Ital. The age of childhood commences with the second dentition, and extends to puberty; including, under ordinary circumstances, in this climate, the period of life between the seventh and fourteenth years. It is the *second infancy*, according to the division of the ages adopted by M. Halle.

a. Organization. At the commencement of childhood, the twenty teeth produced by the first dentition, during the preceding age, become separated from each other, in consequence of the more perfect development of the maxillary bones, and the increased expansion of the dental arches; and, with the exception of the third molaris in each jaw, become loose and fall out, their place being supplied by the appearance, during the progress of childhood and youth, of twenty-six permanent teeth. By the enlarged size of

the maxillary bones, the face assumes a greater depth and breadth, and the general character of the countenance becomes materially changed. Towards the period of puberty, this change is still further increased, in males, by the appearance, upon the upper lip and chin, of fine downy hair, which subsequently increases in thickness and coarseness, constituting the beard of the adult.

While the second set of teeth are making their appearance, all the other parts of the body acquire a more perfect development. The lower extremities assume a size and bulk still more in proportion to those of the upper limbs; and the pelvis, especially in females, becomes deeper and more expanded. The bones are more fully ossified, and those portions of them which were united in the infant by cartilage only, are, during this age, consolidated with the body of the bone. The frontal and maxillary sinuses acquire their full development; the joints, their permanent forms and increased firmness. The muscles are still small, but fuller, and possessed of greater strength than in infancy. In the male, they have also a greater degree of prominence, in consequence of the absorption of the sub-cutaneous fat, and the increased density of the cellular membrane.

The thorax acquires, during childhood, a greater degree of expansion, and the air cells of the lungs augment in size. The dimensions of the larynx are likewise increased, and towards the period of puberty it presents in the male a considerable projection at the anterior part of the neck.

The organization of the brain, and of the nervous system generally, is more perfect than in the infant, and all the organs of sense attain their complete development. Towards the close of this age, the organs of generation in both sexes are fully evolved, and become covered externally with hair. In the female, at this period, the mammæ begin to appear upon the upper part of the chest.

All the parts of the body preserve, during the earlier stages of childhood, much of the softness of infancy; the predominance of the white fluids, however, gradually diminishes, while the various tissues are liberally supplied with arterial blood.

b. Functions. In regard to the functions of life, they all proceed rapidly during this stage towards their full development. Digestion is still extremely active; almost every species of wholesome aliment is rapidly converted into chyme by the stomach, and a frequent and plentiful supply of food is demanded. Nutrition is equally active with digestion; assimilation still predominates over decomposition, and hence the body continues to increase in size.

Calorification is more energetic than in infancy; consequently, the heat of the body is greater, and the influence of cold less severely felt.

The functions of all the external senses are peculiarly acute, and the intellectual and moral faculties augment daily in extent as well as in activity. The powers of observing, comparing, judging, and of reasoning generally, though still imperfect, have acquired a greater degree of accuracy. The memory is still quick and tenacious. Hence this period of life is, with great propriety, the one generally devoted to mental education.

Not only is the intellect in youth more fully developed, but the moral faculties have likewise come into action. The child is now capable of distinguishing between right and wrong, virtue and vice, and of understanding his several duties, whether of a natural, civil, or religious character. He acts less from instinct and feeling, and more from reflection and deliberation than the infant; nevertheless, he is still, in a great measure, the slave of impulse and of passion.

The expressions and gestures of childhood are strongly marked, and very mutable, betraying the great activity of the mind, and the varied sensations that are experienced. This age is noted for great inquisitiveness and extreme loquacity.

Articulation is extremely perfect during the latter periods of childhood; the voice does not, however, attain its full depth and compass, until subsequent to the period of puberty.

The same desire for almost constant bodily exertion exists as in infancy. Confinement of all kinds is endured with difficulty, and if too long continued, is productive of serious injury to health. Sleep is still profound, and a much greater amount is demanded than in the subsequent ages.

As puberty approaches, the genital functions, and the desires connected with them, begin to be developed. The menstrual discharge in females frequently commences at this period.

c. Pathology. The general observations made in reference to the diseases incident to infancy, will equally apply to those of youth. Though cutaneous affections are still frequent, yet the skin is less liable to disease than in the preceding age. The respiratory mucous membrane, and that of the alimentary canal, become readily irri-

tated and inflamed. The brain, also, from the great activity of many of its functions, is peculiarly exposed to disease; hence, violent pains of the head, convulsions, and cerebral inflammations, are of frequent occurrence. From the greater development of the capillary tissue during youth, hæmorrhages, particularly from the nose and lungs, are very liable to take place towards the close of this stage. Tubercular disease of the lungs is often developed during childhood, and scrofulous swellings and ulcerations are not unfrequent. From the amount of exercise to which the body is subjected during youth, inflammations of the joints are often produced. The heart readily sympathizes during this age, with the various irritations that occur in the other organs; hence most of the diseases which then occur are accompanied with febrile symptoms of considerable intensity.

§ 3. Youth. (From the Sax. *Geoguth.*) *νεοτης*, Gr.; *Juventis*, Lat.; *Jeunesse*, Fr. *Jugend*, Germ.; *Giovinezza*, Ital.

The age of youth, or *adolescence*, extends from puberty to the twenty-eighth or thirtieth year. It may be divided into two stages, the first extending from puberty until the period when the body has attained its full stature; the second from this period until the age of maturity. During youth, the genital organs in both sexes receive their full development; the growth of the body in height finishes, and the entire organization arrives at its utmost degree of perfection.

a. Organization. As the body increases in height, the skin loses a portion of its delicacy, and in the male acquires a browner hue, and is covered, particularly on the face, breast, exterior parts of the arms, thighs and legs, with hair, which, towards the period of maturity, becomes often very thick, and of considerable length. The bones of the extremities attain their utmost length and solidity. The muscles become more firm and salient; they are also more deeply coloured, and contain a much larger amount of fibrine in their composition than during the preceding ages. The skin has the appearance, in the male, of being firmly attached to their external surface, in consequence of the increased density of the cellular membrane, and the disappearance in a great measure of the sub-cutaneous fat. The sebaceous follicles become larger and more numerous, as well as the cryptæ of the mucous tissue. The thorax attains in youth its utmost capacity, and gives to the breast, in consequence, an increased breadth and fullness. The articulations appear to diminish in size, in consequence of the greater development of the muscular masses upon the middle of the limbs; while the tendons and ligaments, by which they are surrounded, become more firm and dense; the former communicating to the touch the idea of dry and projecting cords.

The foregoing changes cause the entire frame to assume that appearance of strength and activity peculiar to the latter stages of youth, particularly in those individuals who engage in laborious employments, or make use of much bodily exercise.

By the increased depth and breadth of the face, the anterior portions of the cranium lose, in youth, the disproportion which they previously bore to the rest of the head. At the same time, the forehead acquires a greater height and expansion; the superciliary arches are more elevated, leaving a greater space for the motions of the eyes; and the posterior part of the head becomes larger and more projecting; in consequence, a greater space is afforded for the insertion of the muscles on the back of the neck, and the latter acquires greater breadth and fullness.

It is during youth that the permanent set of teeth become completed by the appearance, between the seventeenth and twenty-first years, of the two posterior molares in either jaw. These teeth, from their being cut so late in life, have received the popular appellation of *dens sapientiæ*, or wisdom-teeth.

During this age, the lungs augment in volume with the increase in the dimensions of the chest. The heart acquires increased force, the capacity of its auricles are augmented, the arteries become large and flexible, the capillary system more fully developed, and the principal veins larger than in the preceding age. The excretory glands increase more in bulk in proportion to the other organs. The lymphatic vessels and glands preserve, during the first stages of youth, nearly the same characteristics as in childhood. The conglobate glands often receive an increased development. The lymphatic temperament, however, gradually diminishes, and finally an equilibrium is established between the red and white fluids of the body.

The brain, still proportionably large, acquires, during youth, an increased firmness; its medullary portion becomes whiter, and its whole organization more perfect. Certain portions of it, particularly the posterior and inferior lobes of the cerebellum, have a greater degree of development. The size, firmness, and organization of the

spinal marrow, ganglions, and nerves, are in harmony with the brain, and other portions of the nervous system.

During the early period of youth, the larynx acquires a considerable augmentation of size, while the opening into the glottis becomes ample, and at the same time more dilatable.

In the male subject, the penis increases to nearly double its former size; and the testicles have an increased bulk, firmness, and weight. The integuments of the scrotum acquire a darker colour and a corrugated appearance, and, in common with the pubic region, are covered with hair. The vesiculæ seminales become developed, and filled with the seminal fluid. At the same time the mammary glands become frequently tumid, and painful to the touch.

In the female, the age of adolescence is, in many respects, marked by different phenomena. The skin is more delicate, smoother, softer, and of a whiter colour than in the male. The cellular membrane is more lax, and the sub-cutaneous fat is in greater abundance. The limbs are more full and round, and the projection of the muscles much less than in the other sex. In the female, the pelvis acquires a much greater development than in the male, but the dimensions of the chest are less. The head and face retain much of the delicacy of childhood: the occipital portion of the cranium, in particular, is smaller than in the male, and hence the posterior part of the neck is inferior in breadth and fullness. The larynx never attains in the female to so large a size as in the male, and forms scarcely any projection at the fore part of the throat. The skin is almost entirely deprived of hair, and its sebaceous follicles are smaller and fewer than in the other sex. While in the male it is the red fluids which predominate during youth, in the female the white fluids are in excess.

The same rapid development of the genital organs is observed in the female as in the male. The mons veneris becomes prominent and covered with hair. The labiæ are elongated and increased in bulk; the cavernous tissue of the clitoris is more voluminous; the dimensions of the vagina are increased, and the ovaries become more tumid, firmer, and more vascular, and small vesicles commence to be formed upon their surface. At the same time the mammæ enlarge and project from the anterior part of the thorax, while the nipples increase in size, and are surrounded with a deep red areola.

The period at which the body attains its utmost height, is about the twenty-first year in the male, and the eighteenth in the female. Professor Quetelet, of Brussels, has found, however, from numerous comparative observations, that in the male, the height frequently increases after the above period, even as late as the twenty-fifth year.

The medium height of the male, in temperate climates, is from five to five and a half feet, and of the female, a few inches less.

b. Functions. The period of puberty awakes in the organism new and peculiar sensations, and gives rise to desires which, during infancy and childhood, had no existence. The organs of generation, which up to this period had remained totally inactive, acquire now their complete development, and becoming susceptible to the action of their appropriate stimuli, are prepared for the exercise of their respective functions. The evolution of these functions produces an important influence upon many of the vital phenomena, which is manifested also during the larger portion of the subsequent ages. The secretion of the spermatic fluid in the male, and the appearance and regular recurrence of the menstrual flux in females, indicate the aptitude of the two sexes for those acts necessary for the continuance of the species; to which they are now impelled by an almost irresistible impulse. To the contention that frequently takes place in early youth between this impulse and the moral considerations which oppose its indulgence, on the one hand, and to its undue or improper indulgence, on the other, are to be ascribed many of the diseases of both mind and body, which occur during this age.

All the functions subservient to the nutrition, enjoy, during youth, great activity, and the growth of the body is proportionably rapid. The desire for food occurs, however, at longer and more regular intervals, than in childhood, and the discharges from the bowels and bladder are less frequent, and very generally take place at stated periods. The feces have greater consistency, and assume the excrementitial character. The urine no longer contains benzoic acid, as in infancy, and the urea is in greater abundance. In consequence of the greater development of the chest and lungs, a larger amount of air enters into the pulmonary cells. Respiration at the same time becomes slower, and the blood, independent of containing a larger amount of fibrine, is more completely arterialized. The general and capillary circulations now enjoy all their vigour; every part is fully supplied with

blood, rich in nutritive particles, and the pulse is full, firm, and quick. Most of the secretions enjoy great activity, and the perspiration assumes a peculiar odour, more perceptible in some individuals than in others. The skin is constantly lubricated with an oily exudation furnished by its follicles, and which, in particular parts, gives a greasy appearance to the surface. The cutaneous exhalation is very copious, while the exhalations into the cellular membrane, and into the cavity of the chest and abdomen, are less abundant than in infancy and childhood. The amount of the sub-cutaneous fat likewise gradually diminishes. The function of calorification is performed with great energy; hence, the temperature of the body is steadily maintained, and the influence of external cold is borne with much greater impunity than at any other period of life.

The force and energy of the muscles, and the general vigour and strength of the frame, render the age of youth the one in which active exercise is performed with the greatest ease, and borne with the least fatigue. Hence, by an almost instinctive impulse, youth is prompted to engage in all those occupations which demand great bodily exertion, strength, and agility. This age is distinguished by the ease, rapidity, and extent, of all the motions of the body. Consequently, the exercise of all the mechanical arts is now acquired with facility, and the utmost degree of skill in all the manœuvres which they demand, is rapidly attained. This, however, is owing not merely to the full development of the hand, and of the muscles by which it is moved, but also to the more complete organization of the brain, and the consequent activity of certain of the mental faculties.

The external senses acquire, during this age, all the extent and accuracy of which they are capable. The tone of the voice, especially in the male, changes from the shrillness and feebleness of childhood, to one more or less deep, full, and sonorous. In the female, the voice never acquires the same depth and strength as in the other sex, but is softer and more flexible.

In regard to the state of the intellectual and moral faculties during youth, perception is clear and accurate; the memory extensive; attention becomes more fixed than before, and the judgment more solid. Youth is the age when the taste becomes refined, and the imagination enjoys all its power and brilliancy, and in connexion with the novel sensations which flow from the development of the genital functions, invests every object with a new and peculiar charm, and clothes the future in the most brilliant hues. The language of youth acquires naturally a warmth and poetic eloquence, unknown to the preceding and rarely equalled in the succeeding ages of life. The arts of music, eloquence, and poetry, are now cultivated with the greatest success, and produce the strongest impression upon the mind and feelings. A taste for these arts may be said, in some measure, to be natural to youth. Impelled by the vehemence of its sensations, and destitute of experience, youth reasons but little, but decides with promptitude, and acts without due reflection. It is hence frequently led into error, and experiences almost daily the pains and disappointments incident upon its rashness, its unreasonable expectations, and its unfounded hopes.

The consciousness of strength and vigour which characterizes this age, renders youth bold, courageous, and enterprising. The young dare everything, overlook all obstacles, and brave every danger, in pursuit of whatever object they may have in view.

Benevolence, generosity, ingenuousness, rashness, and prodigality, are, in general, the characteristics of youth. Its plans are in general grand and disinterested, having, for their object, less its own immediate interest than the good of its country or the happiness of its fellow-beings.

The friendships and resentments of youth are warm, and openly expressed; and though formed with great facility, the first are often endurable, and the latter readily appeased. In love, youth is tender and confiding. Success, however, renders it presumptuous; self-love, indiscreet; and its temperament, changeable.

In the female, the age of youth is marked by an acuteness of observation, a peculiar delicacy of tact, a certain degree of dissimulation and reserve, together with a purity of sentiment, a timidity of manner, and a modesty of demeanor, which increase the graces of her person, and add an almost irresistible force to all her other attractions. During this age, in both sexes, the period passed in sleep is less than in childhood, and is regulated in a great measure by habit. The slumber, however, is still profound.

c. *Pathology.* The age of youth is that in which perhaps the greatest number of the more acute diseases occur. The activity of the circulation, and of the respiratory function; the stimulating properties of the blood; the full development of the capillary tissue; the intense stimu-

lation to which many of the organs are subjected by the new functions that appear at the age of puberty, together with the numerous morbid causes, to which, in youth, the body is exposed, render hæmorrhages, particularly from the lungs; pleurisy; pneumonia; inflammation of the throat, joints, alimentary canal and genital organs; as well as acute affections of the brain and its membranes, and of the spinal marrow, extremely common during this period of life.

The sympathies enjoy, during youth, uncommon activity; and hence, most of the diseases that occur, extend themselves from organ to organ; while they are attended with violent grades of febrile, and more or less nervous, excitement. Their progress is ordinarily extremely rapid, and their termination is often effected by a copious hæmorrhage.

The heart is very often the seat of disease in youth. Hypertrophy of this organ is not uncommon; but frequently its abnormal stimulation, during youth, gives rise to symptoms simulating those produced by enlargement and other alterations of structure, while the organ is still unchanged.

The premature development and undue excitation of the genital organs, give rise frequently to extensive chronic irritation of the stomach and bowels, or of the lungs, the brain, or the spinal marrow. Hence, chlorosis and hysteria in females, and analagous affections in males, and, in both sexes, hypochondriasis, phthisis, various nervous, convulsive, and other affections, even fatuity and mania, are of frequent occurrence in the early periods of youth. A common exciting cause of the chronic irritations of the nervous centres and of the principal viscera, which occur at this period, in the male, is the excessive excitement of the genital organs, by the practice of masturbation.

§ 4. MATURITY. *Adult age. Virility.* *ανδροτης*, Gr.; *Virilitas*, Lat.; *Virilité*, Fr.; *Manheit*, Germ.; *Virilita*, Ital. The age of maturity, strictly speaking, commences when the organism has acquired its utmost development, and continues so long as it enjoys, in their full perfection, all the physical, moral, and intellectual faculties with which it is endowed. We are unable, however, to fix any certain limits between this and the age which precedes and that which follows it; so gradual is the progress of the various organs to maturity, and by such imperceptible degrees do they again decline. We have, nevertheless, placed the age of maturity between the thirtieth and sixtieth years, this being the period of life when, under ordinary circumstances, the principal functions of the system exhibit the greatest degree of energy and regularity.

a. Organization. At the age of maturity, then, the development of the organism, in all its parts, is complete, and all the organs perform their respective functions with vigour, and with the utmost regularity. This, in conjunction with the harmony which then exists between the different portions of the body, renders the enjoyment of health more certain, and causes a greater degree of resistance to be presented to the various causes of disease, than during the preceding or subsequent periods of life.

In the first portion of the adult age, the body has attained its utmost stature, and the trunk and limbs their just proportions. The skin still increases, however, somewhat in thickness and density, and becomes covered, in the male, to a greater extent, with coarse hair. This is particularly the case with the skin of the face and breast. The bones still augment in solidity and in weight, and their projections and depressions become more strongly marked. All the fibrous tissues acquire a greater density, thickness, and firmness; and the muscles show themselves beneath the skin, in bolder relief. The lymphatic vessels and glands have now lost entirely the predominance in their development and activity, which they possessed in the preceding ages.

In the adult, the heart is more powerful, while its motions are more slowly performed, than in youth; hence the pulse increases in firmness, but is less quick than in the latter age. The arteries still predominate over the veins, and their parieties have acquired their utmost degree of firmness, thickness, and density, consistent with their proper extensibility and suppleness. The tissues of the different organs are less soft and spongy, and less permeable by the blood, than in infancy or youth. The digestive and nutritive organs, and those destined to the several excretions, furnish, with ease and regularity, the materials necessary for the maintenance of the body, and remove, promptly and regularly, the various excrementitious particles and fluids. The function of assimilation, and that of decomposition, being in equilibrium, the further growth of the body ceases. The organs of generation perform now their office with uncommon vigour.

It is during the adult age that the marks

of the different temperaments, properly speaking, are first discovered. The changes in the organism, which take place during the preceding ages, prevent their full development, at least to any great extent. The constant modification which the different organs undergo, from birth to maturity, causes them each in its turn to assume a temporary predominance, and thus to clothe each age with its own peculiar temperament. But when the organism has reached its acme, the temperament peculiar to the individual becomes distinctly marked, and in a great measure permanent; influencing, to a greater or less extent, the degree of health which is enjoyed, and the character and progress of the diseases that may accidentally arise. It is true, that when the various organs have acquired their full development, so perfect a harmony should exist between them all, as effectually to prevent any predominance in the size or activity of a single organ or set of organs. This, however, is seldom, if ever, the case. Either in consequence of inherited or congenital peculiarities of organization, or from accidental circumstances affecting the system during the preceding ages, a particular organ or apparatus will acquire an undue development and activity; and this remaining permanent during the rest of life, gives rise to a more or less strongly marked bilious, lymphatic, sanguineous, or nervous, temperament.

b. Functions. All the functions of life have in the adult the same degree of perfection as the organs upon which they depend. Digestion, respiration, calorification, circulation, and nutrition, are performed with the utmost facility and regularity. The apparatus of voluntary motion, though less rapid and agile in its actions, than in youth, is capable of prolonged and powerful efforts. The nervous apparatus is less excitable, but preserves, with greater tenacity, the impressions that are transmitted to it. The want of rest is less felt than in the preceding ages, and sleep is in consequence less prolonged and less profound. The adult does not, in fact, pass in sleep more than a third or fourth part of his time; in other words, not more than seven or eight hours out of the twenty-four.

The intellectual faculties enjoy now all their power. The age of maturity is that of judgment, reflection, prudence, and caution. If the images created by the mind have no longer the same brilliancy as in youth, they have increased in accuracy and truth. The attention becomes now more fixed, reflection more intense; hence the thoughts of the adult are more profound, and his judgments more just and solid. The illusions of youth are dissipated; men and things are better understood, and, being despoiled of all the false attributes with which the imagination of youth is so apt to surround them, they are appreciated at their just value.

Ambition, the love of distinction, the desire of riches and of honours, take insensibly the place of the more amiable and generous sentiments which prompt the actions and inspire the hopes of youth. Friendships are now slowly formed, but permanently maintained; and love, in the adult, is marked more by the prudence and caution of a reflecting mind, than by the impetuosity, the warmth, and the abandonment, which characterized it in youth.

The deep solicitude which the parent experiences for the welfare of a rising family, separates him, in some measure, from other men, and gives to him private interests and feelings, which become the cause of that selfishness of character which in a greater or less degree marks this age, and against which the efforts of reason cannot always shield the heart.

In the adult, the countenance bears the imprint of the peculiar passions and emotions by which the individual is the most frequently agitated. The mobility and frankness which characterized, in the preceding age, the physical expressions, are now most commonly succeeded by the studied immobility or conventional traits prompted by deceit or by prudence, or by that pensive and thoughtful, almost melancholic air, resulting from the cares and anxieties of life, or from habits of deep reflection and close mental application.

No sooner has the organism arrived at that point when it possesses in the greatest perfection all its strength and the full exercise of its various powers and faculties, than it commences to deteriorate. The skin by degrees loses its smoothness and brilliancy, and the muscles a portion of their strength and activity. The flesh becomes less firm and elastic, and the colour of the hair changes to white, and it frequently falls out, to a greater or less extent, from the anterior part of the head. The teeth, from their constant attrition against each other, and their long-continued use in mastication, wear away; at the same time they become in part abandoned at their neck by the gums, less firmly fixed in their sockets, and finally fall out. The wearing away of the teeth is noticed by Professor CHAUSSIER, as one of those

phenomena which mark with the greatest certainty the greater or less advance of the adult age. The period at which the loss of the teeth occurs, is very variable in different cases. In some instances the teeth remain firm and perfect to a very advanced age, in others they are lost very early.

Towards the close of the adult age, the abdomen augments considerably in bulk, in consequence of the greater or less amount of fat which is deposited beneath the skin at this part, the increased volume of the liver, and the immense masses of fat which adhere to the omentum.

In regard to the functions during this period of decline, the appetite decreases, digestion is more slowly and less perfectly performed, the circulation becomes less vigorous, and the process of nutrition and of calorification, less active. The genital organs become gradually less excitable, and no longer execute their functions with their previous promptitude and facility. In the female, between the forty-fifth and forty-eighth years the menstrual discharge becomes less frequent and regular, and finally ceases entirely. The mammæ diminish in size, and become flaccid; the nipple is elongated, its areola dark brown or black; the nymphæ soft and pendulous, and of a paler colour; and the reproductive function ceases in her for ever. In man it is often prolonged to a much later period.

With the decline of the adult age, the heart loses a portion of its force; the veins assume a predominance over the arteries, and are more fully distended with blood than previously; those on the surface of the limbs form often cord-like projections.

The motions of the body are performed more slowly and with less facility, and are more quickly succeeded by fatigue. In the erect posture and in walking, the body is held less firm and upright, and often inclines considerably forwards.

The intellectual functions also have less aptitude for exertion, less energy and clearness, than previously. Everything, in fact, announces the decline of the vital powers, and the near approach of old age.

The symptoms of decline here enumerated, particularly in the male sex, are often so slight as to be scarcely perceptible until subsequent to the period of life that we have assumed as the final limit of the mature age, and do not become very apparent even until many years afterwards.

c. *Pathology.* The adult age, as we have already remarked, is, generally speaking, less predisposed to disease than any of those which precede it. In its first stages, nevertheless, the acute affections of youth are still of frequent occurrence, and the full development of tubercular phthisis often takes place at its commencement. When, however, as is most commonly the case, any particular organ possesses an undue degree of development, or is too constantly or excessively exerted, it will now become readily the seat of disease upon the application of any morbific cause; consequently, the predisposition to disease during maturity will vary greatly in different individuals.

During the course of the present age, in consequence of intemperance in eating and drinking, of a luxurious and indolent mode of living, or other imprudencies, the liver and alimentary canal are liable to become morbidly affected; and hence, dyspepsia, chronic and acute inflammation of those parts, and their consequences, are very frequently met with among adults.

Many of the diseased conditions of the uterus and of the ovaries, together with puerperal fever and affections of the mammæ in the female, and of the urethra, testicles, spermatic cord, and bladder, in the male, may in some measure be considered as more particularly diseases of this than of the preceding or subsequent age.

The urinary organs, also, which ordinarily participate in the morbid excitements of the digestive and genital apparatus, become in the adult frequently the seat of disease; hence, gravel, urinary calculi, affections of the bladder, and induration or enlargement of the prostate gland, are to be ranked among the usual diseases of this age.

Towards the decline of maturity, those organs which during the latter periods of youth and the greater part of the present age, have been the most subject to excessive stimulation, or the most frequently called into violent and prolonged action, exhibit traces of this habitual and excessive excitation in a morbid condition of their tissues, of greater or less extent. It is thus that in persons given to violent muscular exertions, rheumatism, or inflammation of the joints, are commonly met with; as well as hypertrophy and aneurismal dilatation of the heart. In those whose brain is unduly excited by cares, anxieties, intense passions, or by the excessive labour of the mind, disease of that organ, or of the nervous system, generally, is of frequent occurrence.

When the growth of the body has ceased, while the digestive organs are still sup-

plied with a large amount of highly nutritive and stimulating food, and at the same time, from the inactivity of the body, the processes of assimilation and of decomposition are caused to languish, the production of blood exceeds greatly the wants of the system; the vessels consequently become unduly distended, and the principal organs are threatened, upon the slightest increase of irritation being excited in them, to become overwhelmed by fatal engorgements; thus we find at this age, under the circumstances alluded to, that apoplexy of the brain or of the lungs is frequently the cause of sudden death. In other cases, at the same time that the blood-vessels are in a state of plethora, the stomach becomes the seat of a morbid irritation which sooner or later extending to the joints and extremities, gives rise to the various phenomena of gout. It frequently happens, however, that the system disposes of the excess of nutritive fluids by an increased deposit of fat in the cellular tissue throughout the body. The bulk of every part in this case augments sometimes to a most enormous extent; the natural form of the limbs is in a great measure destroyed; the features of the face are nearly obliterated, and the unwieldy size of the whole frame renders it unfit for any degree of active exercise, and almost deprives it entirely of motion.

The decline of the adult age is also that in which various diseases of the arteries and veins are most common; as aneurism, varicose distension, hæmorrhoides, phlebitis, &c.

§ 5. Old Age. Γηρας, Gr.; *Senectus*, Lat.; *Vieillesse*, Fr.; *Griessenalter*, Germ.; *Vecchiaia*, Ital. The fifth and final period of life is that in which the reproductive functions no longer exist; the entire organism is sensibly deteriorated, and all its functions performed feebly and imperfectly. This age commences at very different periods in different individuals. When the development of the organism from the period of birth to that of maturity has taken place slowly and with perfect regularity; when the ages of infancy, childhood, and youth, have been, as it were, prolonged, man, when he has arrived at the age of maturity, enjoys for a long period the perfect exercise of all his faculties, and the symptoms of decay are slow in making their appearance. Old age is postponed in such cases to a very late period. But when the organism has arrived rapidly to maturity, decay as rapidly ensues, and old age follows quickly upon the termination of youth. Taking, however, the ordinary course of human life, old age may be said generally to commence between the fiftieth and sixtieth years; its natural termination is always in death.

a. Organization. In old age the whole body diminishes in bulk, becoming often extremely emaciated; the limbs are thin, the knees bend under the weight of the body, the spine inclines forwards, and the erect stature of the preceding age is entirely lost. The skin becomes darker coloured, drier, and more scaly, and is thrown into numerous wrinkles. The face partakes of the general emaciation; the cheeks fall in, and the lips become thin and pale. The forehead, in consequence of the augmented size of the frontal sinuses and the loss of the hair, appears disproportionately large, when compared with the face, which is diminished in size from the absence of the teeth and the absorption of the alveolar processes of the jaws. The chin in old age projects more than during the preceding stage, and approaches nearer to the nose, which latter is generally thin and peaked.

The hair of the head, eyebrows, and beard, is greatly thinned or entirely lost; the colour of that which remains is always more or less of a silvery white. The bones in old age are large in size and more compact than during youth or maturity. Their internal cavities are also more developed; the long bones, in particular, become complete cylinders and almost entirely hollow from one extremity to the other. Their projections and depressions are very strongly marked. The medulla with which their cells are filled becomes more and more fluid. The phosphate of lime which enters into their composition is in larger proportion than in the preceding ages, and the proportion of gelatine is less. The bones, in consequence of these changes, are more readily fractured, and their specific gravity is diminished.

The ligaments of the articulations become less pliable and elastic; the cartilages acquire an increased density, and those of the ribs and sternum are in general completely ossified. The sutures, symphyses, and other immovable articulations, become obliterated, and many of the movable articulations partially anchylosed. Ossification frequently takes place, to a greater or less extent, in the coats of the arteries and veins, and in many of the membranes, as well as in the fibro-cartilaginous plates of the trachea and bronchi.

The digestive organs and those of nutrition equally deteriorate. The teeth fall

out; the salivary glands and pancreas diminish in size; the stomach and intestines become more capacious, while their coats are thinner, softer, and paler, than in the adult. The rectum is very distensible, and often becomes loaded to a great extent with hardened feces.

The absorbent vessels diminish in size, and apparently in number; and the lymphatic glands become in many instances so small as to be scarcely apparent.

The heart is shrunk, particularly its ventricles, and becomes pale, flabby, and often surrounded at its base with a considerable amount of fat. The arteries are diminished in calibre and less pliable than in the preceding ages, and their coats are more brittle and often cartilaginous or even ossified. The veins are capacious, thin, soft, and frequently varicose. They are always distended with a large quantity of blood, while the capillary system of all the tissues receives and circulates a much less amount of blood than previously.

The greater part of the secretory organs, particularly the liver, the kidneys, and the testicles, are softer, paler, and less cellular and vascular, than in the preceding ages. The biliary and urinary bladders are more capacious, and their coats are thinner. The lungs are less voluminous, soft, grayish, and often present black spots or patches on their surface; the pulmonary cells are greatly enlarged, while their capillary structure is much less extensive than in youth and adult age. The specific gravity of the lungs becomes singularly diminished as old age advances. The larynx is large and often completely ossified.

The organs of the senses experience a striking deterioration. The eyes become sunk within their sockets, from the absorption of the fat which previously existed at the bottom of these cavities. The ball of the eye is flattened, the cornea and crystalline lens are less convex and transparent, and consequently the powers of refraction are sensibly diminished. The iris and choroid coats acquire a paler hue, from a diminution in the amount of the pigmentum nigrum. At the same time, in consequence of the white colour of the eye-brows and lashes, or their entire loss, and the everted state of the lower eye-lid, the eye is less perfectly defended from the light and atmosphere, and becomes red and watery. The external ear becomes thinner and more flaccid, and the cavities of the labyrinth are, most generally, deprived in old age of the limpid fluid with which they are ordinarily filled. The organs of taste and of smell undergo the least change.

The brain in old age is very firm; its veins are large, numerous, and gorged with blood; its membranes, and particularly the dura mater, are more dense than previously, and the latter often presents patches of a cartilaginous consistency, or even of complete ossification. The nerves are diminished in size, very firm and solid. The optic nerve, especially, is occasionally in a state of complete atrophy.

The muscles become paler, softer, more flaccid, and less in size, as old age advances. Their tendons are hard, stiff, and often encrusted, towards their terminations, with the phosphate of lime. The synovial fluid of the joints and sheaths of the tendons is greatly diminished in quantity.

The organs of generation are, as it were, withered: the testicles, the vesiculæ seminales, the spermatic cord, and the penis, are all diminished in size, and the latter is no longer capable of erection. In the female, the womb is reduced to the same size it had in infancy—the ovaries are less in bulk, and of a hardness almost amounting to scirrhosity. The external parts of the female organs are withered and relaxed. The mammæ have entirely disappeared.

b. Functions. The decay of the several organs in old age produces a proportionate decrease and deterioration in all the phenomena of life. The appetite diminishes and is less discriminating; mastication is rendered impossible by the loss of the teeth and the deficiency of the salivary secretion. Digestion is slow and imperfect. The bowels are inert, and allow the feces to accumulate within them, and days, or even weeks, elapse before their discharge is effected. Nutrition is very imperfectly performed, the process of decomposition predominating over that of reparation; hence the body not only ceases to grow, but many of its organs absolutely diminish in size.

Respiration becomes much slower than in the preceding ages, and is performed almost entirely by the diaphragm, in consequence of the immovability of the ribs. The dilatation of the chest is hence imperfect, and from this circumstance and the increasing slowness with which the blood is transmitted through the lungs, together with the diminished extent of their capillary system, the arterialization of the blood is rendered less and less perfect. The atonic state of the bronchial ramifica-

tions, and the increased amount of mucus which their lining membrane exhales, are perhaps other causes of the diminished change which the blood undergoes in respiration. The blood in old age is not only darker than in the preceding periods of life, but it is also more serous, less rich in red globules, and remarkable for its want of plasticity.

The diminished force and activity of the heart, the diminished elasticity of the arteries, and the dilated and engorged state of the veins, cause the circulation in old age to be slow and languid throughout all the organs.

The circulation through the lymphatic vessels is equally inactive; the serous fluids have hence a tendency to accumulate in the more depending parts of the body—in consequence, the feet and ancles very generally become tumid, towards evening, in old persons; the swelling being caused to disappear by the recumbent posture assumed at night.

The exhalation from the lungs is but little changed in old age, while that of the skin is almost entirely suspended; hence the peculiar dryness and roughness of the surface at this period of life. Internally, the serous, synovial, and fatty exhalations, are likewise greatly diminished. The secretion of mucus would appear, however, to be in general considerably increased; hence the habitual cough and frequent expectoration of old people, and the slimy discharges from the bowels, urethra, and bladder, so common at this age. The urinary discharge, though diminished in quantity, contains a larger amount of its peculiar saline principles, and is more highly charged with azote than it is earlier in life. The secretion of bile is diminished, and that of semen almost entirely suspended.

In the aged of both sexes, calorification is extremely feeble; consequently, the temperature of the entire body is less than in mature age: the feet and hands are in general cold, and any considerable or sudden diminution of temperature is borne with difficulty. During cold weather the aged suffer much, and many are destroyed.

The sensations of the old are blunted, and gradually become obliterated. The sight diminishes in acuteness, being commonly more distinct for remote than near objects—the reverse, however, is occasionally the case. As old age advances, the sight is often entirely lost. Hearing becomes blunted, and the ear distinguishes sounds with great difficulty—complete deafness is not unfrequent. In consequence of the increased thickness and dryness of the skin, and its diminished vitality, its sensibility is greatly reduced; and from the impaired mobility of the hand, the accuracy of touch is in a great measure lost. Smell and taste remain longer active than either of the other senses.

Perception during old age is slow and imperfect, and becomes more and more difficult, until finally it is confined almost entirely to that produced by the immediate wants of the individual or attendant upon their gratification. Even this is often entirely lost, and an imperfect vegetative life is all that remains.

In advanced age the memory is but little retentive and very inaccurate in relation more especially to new facts and recent occurrences—while ideas acquired in youth, and circumstances that have transpired at a remote period, are remembered with great precision. The aged fall constantly into error, therefore, in regard to the events of yesterday, but recount with tedious minuteness and perfect accuracy those of which they had been the subject or the witness in their earlier days. Forgetting almost immediately the subject of their last conversation, they subject their hearers to repeated recitals of the same dull narrative.

The attention being excited but little during old age by surrounding objects and passing events, the mind is in consequence absorbed in deep reflection and constant meditation. The judgments which it forms are in consequence generally accurate, which, in connexion with the accumulated experience of ages, renders the advice of the old in general very precious. Being no longer misled by the violence of their passions, or deceived by the illusions of life or by the brilliant creations of a vivid imagination, the aged become cool, cautious, and philosophic—but at the same time timid and suspicious. Old age is necessarily selfish. The blunted sensations, and the feeble impressions which they experience from external objects, shut out, as it were, the old from the world, and concentrate all their thoughts and feelings upon themselves; while the consciousness of their feebleness, and the little hold they have upon the things of life, beget the fear of want, and render avarice a common attendant upon the closing stage of existence.

From the same causes, aged persons lose in general all desire to please and conciliate those with whom they associate —they become, in consequence, indifferent to dress and to the conventional forms and

habits of civilized life; even to those cares of their persons and clothing, which a proper regard for cleanliness and decency demand. Indifferent to the feelings, the prejudices, or the opinions of others, they assert with positiveness, contradict with the utmost bluntness, and reprove with harshness.

In old age the voice becomes hoarse, weak, and tremulous, and the articulation imperfect, in consequence of the loss of the teeth, the immovability of the larynx, and the imperfect dilatation of the lungs in inspiration. The expression of the countenance is grave, imposing, and monotonous.

The general movements of the body diminish in power, activity, and precision, as old age advances. The whole frame bends upon itself; hence the aged walk with difficulty, and always with a slow, infirm, and staggering gait. In the upright position, the body now requires, from the great inclination forwards of the trunk, an additional point of support, and hence a cane is the common companion of persons advanced in life.

In the advanced period of old age, as in the infant, life seems to be divided between sleep and the satisfaction of hunger and thirst. Repose is, however, less perfect than in the adult, being readily disturbed, but as readily resumed.

It occasionally happens that a state of complete imbecility and decrepitude precedes for some time the final extinction of life. The external senses and all the functions of relation are completely obliterated or very nearly so; the moral and intellectual faculties are no longer active; frequently all power of voluntary motion is lost, and the individual is confined to his arm-chair, or to bed, by a universal paralysis—a vegetative existence is all that remains. As in the infant, aliment and drink must be poured into the throat, as neither the existence of hunger or thirst, nor the dictates of reason, inform the individual of the necessity of taking them. The excretions are either retained, or are discharged involuntarily, until life is finally extinguished without a pang or a struggle.

c. *Pathology.* In individuals who have always lived regular and active lives, who have avoided every species of excess, and whose bodies have been happily preserved from the influence of any of the more active morbific agents, the first period of old age is generally marked by an uncommon degree of health and exemption from disease. Unfortunately, however, it too often happens that old age is rendered uncomfortable, and the body a ready prey to disease, in consequence of one or more of the organs suffering now from the effects of those morbid states and that undue degree of excitement, of which they had been the seat in the previous stages of life. Hence, old age is very generally accompanied by chronic affections of the brain, stomach, bowels, liver, heart, lungs, urethra, and urinary apparatus generally. Hebetude of the intellectual faculties, deprivation or entire loss of the external senses, paralysis of the muscles, a neuralgic state of the nerves, dyspepsia and other chronic affections of the stomach, with their attendant evils, hepatic enlargement, hæmorrhoides, gout, rheumatism, gravel, urinary calculi, enlarged prostate, strictures of the urethra, asthma, irregularity in the actions of the heart, &c., are consequently among the diseases most frequently met with towards the closing stages of existence.

During old age, asthma is of very common occurrence, and is often dependent upon the very great enlargement which then takes place in the pulmonary cells, in conjunction with an ossified state of the valves of the heart and the dilatation of the right ventricle.

In consequence of the engorged state of the veins of the brain in advanced life, apoplexy and palsy are readily induced by any undue irritation of that organ, or by the least impediment to the free return of the blood from the vessels of the head. From the venous plethora of the abdominal viscera, extensive discharges of dark coloured blood often take place from the stomach and bowels.

Catarrhal affections are common in old persons, and are attended with very considerable fatality, from the engorged state of the lungs and the great quantity of mucus which is thrown out into the pulmonary cells.

Ossification of the coats of the arteries, to a greater or less extent, and of the valves of the heart, and a varicose condition of the veins, particularly in the extremities, are ordinary attendants upon old age.

In consequence of this diseased condition of the blood-vessels and the diminished vitality of all the tissues, spontaneous ulceration of the lower extremities, or even mortification of the toes, feet, and legs, are not unfrequent during this stage of life.

The eyes are generally affected with more or less of chronic ophthalmia—the cornea, also, is commonly diminished in transparency, and the lens opaque. An amaurotic condition of the eye is occasion-

ally met with, arising from atrophy of the optic nerves.

The softness, flaccidity, and general atonic state of nearly all the tissues in advanced life, explains the cause of the frequency of hernia and of prolapsus of the womb and anus in old people.

The skin is often affected at this period with chronic eruptions of various kinds.

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D. F. CONDIE.

AGES. (*Medico-legal.*) Although this subject is by no means as important in a medico-legal point of view as the earlier writers have supposed, still there are some questions of no slight interest, which mainly depend for their elucidation on the verification of the ages of the parties concerned; as, the age of a new-born fœtus, the age at which pregnancy can occur, &c., personal identity, &c. It is true that in many cases where it becomes a point of debate, the laws have so defined the stages of existence, that the testimony of a medical man can throw but little more light upon the subject, than that of any other individual. There are cases, however, of no unfrequent occurrence, where a knowledge of the physiological and anatomical proofs of the real age of individuals, is of the utmost consequence. To avoid unnecessary repetition and confusion, these will be detailed as succinctly as possible, without reference to the questions requiring this elucidation.

Fœtal life. In the article, *Abortion,* (*q. v.*) the marks by which the age of a fœtus up to the term of three months of utero-gestation may be ascertained, have been detailed. As, after this epoch, it may become necessary to ascertain the period at which the child has been destroyed by the production of premature labour, or by actual violence, the following proofs, derived from the observations of BECLARD, CHAUSSIER, VELPEAU, MECKEL, &c., may prove useful. *Three months.* Length, 4 inches. Weight, $2\frac{1}{2}$ to 3 ounces. Head heavier than the rest of the body. Skin of a fibrous consistence. Pupils closed by a membrane. Eye-lids adhering together. Mouth large, lips completely formed. No ossification in the pelvic bones. Ileo-cœcal valve visible. Both ventricles of the heart distinguishable. *Four months.* Length, 5 to 6 inches. Weight, 5 to 7 ounces. Skin of a pink colour, and consistent. Meconium apparent, somewhat coloured. Longitudinal sinus of the brain perceptible. Ossification of the bones of the ear, commencement of ossification in the sacrum. Kidneys very large, having 15 to 18 lobes; capsulæ renales as large as the kidneys. Middle of the body above the umbilicus. *Five months.* Length, about 8 inches. Weight 1 pound. Head covered with short, fine hair. Skin of a purplish red. Nails visible. Commencement of ossification in the sternum, pubis, and os calcis. Lungs very small. Heart large, the auricles as large as the ventricles. Ductus arteriosus and both branches of the pulmonary artery, of the same size. Gall-bladder distinguishable. Muscles beginning to become fibrous. *Six months.* Length, 10 to 11 inches. Weight, 2 pounds. Appearance of dermoid texture in the skin. Eyelids still adhering together. Ossification

in several parts of the sternum. Meconium in the cœcum. Lungs small and reddish, bronchi distinctly visible. Liver of a deep red colour. Testicles a little below the kidneys, which latter show some cortical substance. *Seven months.* Length, 13 to 14 inches. Weight, 3 to 4 pounds. Skin pink, fibrous, thick, some sebaceous coating. Nails not yet reaching the extremities of the fingers. Eye-lids separated, membrana pupillaris not so distinct. Ossified point in the astragalus. Meconium in almost every part of the large intestines; valvulæ conniventes beginning to appear. Left lobe of the liver nearly as large as the right. Brain more consistent. Testicles at a greater distance from the kidneys. *Eight months.* Length, 15 to 16 inches. Weight, 4 to 5 pounds. Skin more coated with sebaceous matter. Nails reaching the extremities of the fingers. Membrana pupillaris, disappearing towards the close of this month. Point of ossification in the last vertebra of the sacrum. Brain showing an appearance of circumvolutions, but still entirely formed of the gray substance. *Nine months.* Length, 16 to 18 inches. Weight, 6 to 8 pounds. Middle of the body a little above the umbilicus. Skin covered with a white coating. The upper extremities from the arm-pit to the end of the fingers, longer than the lower extremities, measured from the groin to the heel. No membrana pupillaris. The occipital bone in four parts. No ossification of the hyoid bone. Ossified point in the cartilaginous epiphysis at the lower part of the femur. Some appearance of white substance in the brain. Testicles out of the abdomen.

These data, however, though the result of numerous observations, and generally correct, are far from being rigorously exact. The size of the infant (weight and bulk) differs at the same age not only with different mothers, but even with the same individual in her successive pregnancies, the period of conception, age, constitution, and manner of life, with a variety of adventitious circumstances, all tending to produce exceptions to any general rule.

The only mode by which a medico-jurist called upon to verify the age of a fœtus, can hope to decide with any certainty, is to pursue his investigations in somewhat the following order. 1. The state of the placenta and its appendages, as its dimensions and consistence; the presence or absence of the umbilical vesicle and its vessels; the length of the umbilical cord, &c. 2. The state of the fœtus itself and its organs, as its weight and length; the place of insertion of the umbilical cord; the colour and consistence of the skin, and whether it is coated with sebaceous matter; the length and consistence of the nails; the presence or absence of the membrana pupillaris; the state of the nostrils, mouth, and ears; the development of the intestinal canal, and the colour of the meconium; the relative size of the liver and its gall-bladder, the kidneys and their capsulæ renales; the situation of the testicles, &c.

Extra-uterine life. The determination of the precise stage of existence of an individual after birth is attended with even more difficulty than during the fœtal state. As has been noticed in the preceding article, extra-uterine life has been divided into several epochs, the limits of which have been fixed at such different ages by almost every writer, that it would be useless to attempt to say anything further on the subject. To facilitate reference, however, we shall notice the proofs under the following heads. 1. Infancy; 2. childhood; 3. adolescence; 4. adult age; and 5. senility.

Infancy includes the first seven years, and may itself be divided into three stages; 1. from birth to the seventh month; 2. from seven months to two years; 3. from two years to seven. During the first of these stages it oftentimes becomes important to verify the exact age, as, for instance, in cases of infanticide. So much light has been thrown on this subject by Denis and Billard, grounded on researches on the state of the umbilical cord, that an abstract of their observations cannot fail to prove useful. In a new-born infant, the cord is firm, of a bluish colour, and rounded; it may be thick or thin, according as it contains more or less gelatinous matter, and its vessels are filled with blood.

The *first* change that takes place is the withering of the cord. This may begin immediately after birth, or not for some hours; but is always accomplished before the expiration of the second day. The cord is now soft, and in many cases there is a puffiness around the umbilicus. The *next* change is the drying of the cord. It becomes darker coloured, and the gelatinous matter disappears. The vessels are now well marked, but are flattened, and are either empty or contain a little coagulated blood. This desiccation commences during the first or second day, and is usually completed at the end of the third. The *third* change is the separation of the cord. This occurs from the fourth to the

sixth day. The base of the cord becomes, as it were, eroded; the umbilical arteries give way first, and then the vein. If inflammation of the umbilicus supervenes, traces of it remain visible till the tenth or twelfth day. The *fourth* change is the healing of the umbilicus. This takes place from the tenth to the twelfth day, according to the size and fullness of the cord. About this time also a cracking of the epidermis is perceptible. The *fifth* change consists in the perfect closure of the vessels and sinking in of the umbilicus. This happens from the twelfth to the thirtieth day after birth; and by the fortieth, in most cases, the process is perfect.

Bernt states that some assistance in this inquiry may be derived from the condition of the arterial duct. If a child has breathed for a few moments only, observes he, the aperture by which this duct enters the aorta becomes oval, and its aortal end contracts, so that the vessel forms a cone. If the child has lived for some days, it reassumes the cylindrical shape, but is much contracted in size. When the child is a week old, the duct will be found not larger than a crow-quill, and much wrinkled. Orfila lays some stress on the desquamation of the cuticle, but we must refer those who wish for further information on this point, to his work.

From the fortieth day until the second stage of infancy, it is exceedingly difficult to decide with precision on the exact age of the child. Some approximation can always be made, but children differ so much in the development of both their body and mind, that no certain data can be fixed upon, nor will an examination after death be attended with any more satisfactory results. It is said, however, that about the fifth month, ossification commences in the cuboid bone of the tarsus.

During the second period of infancy, the phenomena of dentition afford criteria by which the age of the child may be ascertained. (See *Dentition.*) It should, however, be borne in mind that this process varies exceedingly in different children, and should not therefore be taken as an unerring guide.

As regards the third period, we have more certain information, from the researches of Beclard. He states that at the age of 1 year, there is a point of ossification at the inferior extremity of the humerus and cubitus, and in the heads of the humerus, femur, and tibia. At 2 years, an osseous point exists in the inferior extremity of the radius, tibia, and fibula. At $2\frac{1}{2}$ years, ossification of the head of the humerus, of the patella, and of the lower extremities of the last metacarpal bones, and the vertebral canal, is completely formed. At 3 years, a point of ossification in the great trochanter, and the pyramidal bone of the carpus. At 4 years, ossification in the second and third cuneiform bones of the tarsus. At $4\frac{1}{2}$, the small tuberosity of the humerus and upper extremity of the fibula become ossified. About this time also the third molar teeth make their appearance. At 5, the trapezium and naviculare become solid. At 6, the os pubis becomes joined firmly to the ischium. At 7, the first set of teeth begin to fall, in the order of their development.

Childhood. As an individual advances in life, the distinguishing marks by which the age may be ascertained, become not only less numerous, but also less decisive. Several phenomena, however, occur, which are deserving of attention, as affording some clue. About the 8th or 9th year, the fourth molar tooth appears, and an ossified point is to be seen in the scaphoid bone of the carpus. At 9, the bony union of the three portions of the ilium, forming the acetabulum, is completed. At 12, the pisiform bones are solidified.

Adolescence. At 15, the coracoid process becomes firmly united to the scapula, and the olecranon is consolidated with the humerus at 15 or 16. During the latter year also, there is an ossified point in the external tuberosity of the humerus. At 18, all the epiphyses of the upper extremity of the femur become firmly attached. From 18 to 19, this union also takes place in the epiphyses of the last metacarpal bones. At 25, all the epiphyses have become bony and united.

As regards the other epochs of life, no rule can be laid down; for although there are marked differences between adult and old age, the change from one to the other is so gradual, and is so much modified by circumstances, as to render it impossible to verify the age from them.

The applications of these and other collateral data, are as various as the questions that may require their aid, and will be here noticed in a cursory manner only, as they will be treated on *in extenso* under their proper heads.

In *infanticide* it is evident that much of the proof depends on verifying the age of the child, especially in those cases where there has been an attempt to conceal the body, or where it has been found exposed, and has perished from cold or neglect. (See *Infanticide.*)

Inheritance. It often becomes impor-

tant to ascertain whether a child was born alive, as the disposition of property may be dependent on this fact. Hence it is requisite that a physician should be able to decide from an examination of the child whether it could have been *viable*. As a general rule, it may be affirmed that no infant can be born, capable of living, under five months after conception. It is true, there are cases to the contrary. (*Ed. Med. and Surg. Journ.*, II. 455. XII. 126. 251.) Between this period and seven months, there are but few instances of children surviving, and even at seven, the chances are greatly against the child.

Rape. As by common law, a boy under the age of fourteen is considered incapable of committing this offence, on the ground of imbecility of body, it is of great importance, in some cases, to establish the fact of the age of the accused; and it has also been held, by eminent authority, that the consent of a female between the ages of ten and twelve, is no mitigation of the crime. (See *Rape*. *Puberty*.)

Personal identity. The age of the parties is oftentimes a point of the highest moment in these perplexing cases, and though circumstantial evidence must be mainly trusted to, the evidence of medical men, as to age, &c., will often throw much light on the subject. (See Fodere, I. 124.)

Survivorship. It has been repeatedly necessary to establish the fact of survivorship, under very perplexing circumstances, as, where several persons in a family have perished together, without there being any witnesses of the event. In these cases, the relative ages of the victims is allowed great weight in the determination of which perished the last. At the same time, so many concomitant circumstances must be taken into view, that it would be always difficult to decide on mere physical principles.

The rules of common law in England, as regards age, and which are generally in force in the United States, are too numerous and diversified to detail in this place. Some of the most important, however, require notice. Thus, 14 years in the male, and 12 in the female, have been ruled to be ages of discretion for consenting to a marriage. At 14, also, a minor may make choice of a guardian. Twenty-one is full age, before which, no purchase made or contract entered into, except in certain cases provided for by law, is valid. As regards crimes, it is ruled, that children under 7 years of age are without discretion, and are exempt from punishment; between 7 and 14 some latitude is allowed, and if they appear to possess a sense of crime, they are liable to punishment; but in most cases the rule of presumption is that a child under 14 is *indoli capax;* after this age that he is *doli capax*.

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R. E. Griffith.

AGEUSTIA, or AGHEUSTIA. (From α, priv. and γευστις, taste.) Diminution or loss of taste. Some nosologists have founded upon this condition a genus of diseases; it is, however, a mere symptom, resulting either from the state of the mucous membrane of the tongue and its secretions, or from a defect in the nerves of this organ. (See *Taste*, *pathological states of*.) I. H.

AGGLUTINANT. (From *agglutinere*, to glue together.) *Agglutinant*, *Agglutinatif*, *Glutinatif*, Fr.; *Klebrig*, Germ. Substances possessing an adhesive property, and which are employed for the purpose of maintaining the lips of wounds in contact until they unite by cicatrization. (See *Plasters*, *adhesive*.) I. H.

AGNINA MEMBRANA. Aetius, Bartolin, Drelincourt, and others, have given this epithet to the *Amnios*. I. H.

AGONY. (From αγων, a combat.) *Agonie*, Fr.; *Todesangst*, Germ. This has been poetically defined to be the last struggle of life against death. It may be more strictly said to signify the series of phenomena which usually precede death, and which result from the gradual and successive abolition of the functions. The symptoms, characteristic of agony, are, complete prostration; total extinction of sensation and of intellect; fixed features; eye-balls rolled up; coldness of the body, particularly of the limbs; inability to speak; slow and laborious respiration, accompanied with tracheal rhonchus, vulgarly termed the "rattles;" small, irregu-

lar, intermittent and sometimes imperceptible pulse, though the beating of the heart may be still distinguished, either by the application of the hand or ear, to the pericardial region.

Most, and perhaps all, of the preceding phenomena, may occur without death being the inevitable result; thus constituting what is termed apparent or false agony. On the other hand, death is not always preceded by agony. This is readily explained. The functions are not all of equal importance. There are some, as innervation, circulation, and respiration, the sudden and complete suspension of either of which, produces instant death. Others, as digestion, absorption, secretion, &c., may be suspended a considerable time without being fatal; and they ultimately prove so, only when they have been arrested so long as to affect the three primary functions just enumerated. When, then, one of the organs which preside over these three functions, is rendered suddenly and completely incapable of performing its office, death promptly takes place. Thus, a sudden abolition of innervation, from a violent lesion of the medulla oblongata, or from the action of certain poisons; an arrest of the circulation, from rupture of the heart or aorta; or the sudden stoppage of respiration, cause instant death, without any distinct manifestation of agony. This may also happen, when a disease advances so slowly that the organ insensibly reaches the condition at which it is incapable of any longer performing its functions; as in some cases of phthisis, and in certain diseases of the heart. With these exceptions, death is always preceded by agony, of longer or shorter duration. The fundamental phenomena of agony appear to denote a lesion, either primary or secondary, of the cerebro-spinal nervous system, the system which presides over the functions of animal life. The term of agony is death, and it is under the latter head that the manner in which the functions become extinguished will be more properly considered.

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I. H.

AGRIMONIA. Agrimony. Cocklebur. *Aigremoine*, Fr.; *Odermennig*, Germ.

Sex. Syst. Icosandria digynia. *Nat. Ord.* Rosaceæ.

Gen. Ch. Calyx five-cleft, with a lobed appendage at its base. *Petals* five, inserted upon the calyx. *Pericarps* two, in the bottom of the calyx. Hooker.

This genus contains but few species, all of which, however appear to possess the same properties. The only one recognized in the Pharmacopœias is the *A. eupatoria*, one of the most widely disseminated plants yet known, being found in Europe, Asia, and North America.

A. eupatoria. Hirsute; leaves interruptedly pinnate, terminal leaflet petiolate; spike virgate. Elliot.

The decoction of this plant is used in Europe as a mild astringent, in common sore throats. Alibert also recommends it in various diseases of the genito-urinary organs, and Pallas states that it is employed in Russia as a specific against worms in domestic animals. It likewise forms part of the Materia Medica of our Indians, who employ an infusion of the roots in inflammatory fevers: in this practice, according to Kalm, they have been followed by the Canadians, who have great reliance on its febrifuge powers.

The chemical composition of this plant has not been accurately ascertained. All that is known in this respect is that it contains an essential oil, and that it strikes a black colour with the salts of iron. Dambourney observes that the leaves and stalks afford a dark yellow decoction, which imparts a beautiful and permanent gold colour to wool previously impregnated with a solution of bismuth.

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R. E. Griffith.

AGRIPPA. (*Obstetr.*) Those who had been born with their feet first, were so termed. *Partûs agripparum*, an expression employed by some writers to designate delivery by the feet. The derivation of the term is unsettled. I. H.

AGRYPNIA. (From α, priv. and ὑπνος, sleep, Sleeplessness. Insomnia. Sauvage considered this as a disease; it is a mere symptom. I. H.

AGRYPNOCOMA. (From α, priv. ὑπνος, sleep, and κωμα, coma.) Restlessness and jactitation, with drowsiness or stupor. Coma vigil. I. H.

AGUE. The chill or cold stage of intermittent fever. Sometimes employed, for brevity sake, for Ague and Fever, Intermittent fever, (*q. v.*) I. H.

AGUE CAKE. *Gateau fébrile*, Fr. *Placenta febrilis. Physconia splenica*, &c. The popular term for the enlargement of the liver, or spleen, particularly of the latter organ, which frequently occurs in those who have experienced repeated attacks of intermittent fever; and is very common in miasmatic districts. (See *Spleen*, *Liver*, and *Intermittent Fever.*) I. H.

AIR. (From αω, I breathe.) Αηρ, Gr.; *Aër*, Lat.; *Air*, Fr. By the term Air, is now universally understood, common or atmospheric air; the colourless, transparent, ponderable, permanently elastic fluid, which constitutes the principal part of the atmosphere of our planet.

The present article will be devoted to the investigation of the effects of this fluid when accidentally introduced into the veins, into the cavities of the body, and when brought in contact with tissues ordinarily protected from its direct action. Its chemical and physical properties; the influence it exercises upon the human system by virtue of its chemical composition; and the effects which result from its action in mass, and from its various states and admixture with other substances, will be elsewhere considered. (See *Atmosphere*, *Respiration*, *Blood*, *Pus*, *Meteorology*, *Epidemics*, &c.) I. H.

§ 1. *Action of air, when admitted into the veins.* The injection of a certain quantity of atmospheric air into the venous system of animals, produces sudden death. This fact was long since known to anatomists and physiologists. Wepfer, Redi, Bohn, Vander-Heyden, Camerarius, Brunner, Harder, Sproegel, Vallisnieri, Lieutaud, Morgagni, Rudolphi, Portal, Bichat, and Nysten, had made experiments on living animals, or had seen dissections, which demonstrated it.

As a fatal accident in surgical operations, the occurrence was not publicly known before 1818. No doubt a multitude of instances had existed long before that period; but their nature being unknown, they were imputed to syncope, terror, hæmorrhage, or some other cause. In the year just mentioned, a surgeon in Paris, M. Beauchene, operating on a young man in the Hospital St. Antoine, for a tumour of the neck, had occasion to raise and disarticulate the clavicle. At the moment this was effected, the patient cried, "I am a dead man." He became faint, and died in 45 minutes after the beginning of the operation. On examining the body, an aperture was found in the internal jugular vein, where it joins the subclavian. In the year 1822, M. Dupuytren experienced a similar accident in the Hôtel Dieu. The patient, a well-constituted girl, had a tumour on the neck, which extended from the mastoid process to the clavicle and scapula. The operation for its removal was nearly completed; the tumour hung suspended by a portion of integument, when suddenly a hissing noise was heard, like that arising from the rushing of air into an exhausted receiver; and the patient exclaimed, "I am dying:" she was immediately seized with a general trembling, sunk in her chair, and fell down without motion and life. On examination of the body, air was found in the right auricle, and in other parts of the circulatory system. Not long after this, Dr. Mott and Dr. Stevens, of New-York, witnessed the accident; and since, it is said to have occurred to Dr. Castara, of Lunéville; Prof. Delpech, of Montpelier; Prof. Graefe, of Berlin; Sir Astley Cooper, and others. Among the most recent cases which have come within our knowledge, are the following, which occurred to the writer of this article, in the Massachusetts General Hospital.

Case I.—Mr. William Burrill, of Salem, aged 60, was admitted into the Massachusetts General Hospital, on the 16th Oct. 1830. He had a cancerous affection of the left side of the face and neck, of the extent of three or four inches diameter. It was hard at the edges—of a livid red colour—ulcerated in the centre—very offensive—very painful—and had made an impression on the general health. The parotid gland, the submaxillary, the sublingual, and all the textures, excepting the bone, were involved in the complaint. The lower jaw was thought to be diseased, at first, but it afterwards appeared not to be so. In so bad a state of things, there seemed to be little hope of eradicating the disease, and the operation would not have been attempted, had not the patient solicited it.

Considering the extent of the disease; that important blood-vessels would be divided, namely, the facial and sublingual arteries, probably the temporal, and possibly the external carotid; it was thought best to secure the carotid trunk. An incision, for this purpose, was begun opposite the thyroid cartilage, and carried two inches, downwards. The platysma muscle was divided; the edge of the mastoid exposed and dissected. Thus far, only a few drops of blood were discharged. The face of the sheath of the great vessels was a

little uncovered, when a small effusion of venous blood appeared under the knife, and checked the operation. At that instant a very distinct sound was heard, like the passage of air through water. A few bubbles were seen in the venous blood, the flow of which was immediately arrested by applying a finger on the part. The patient exclaimed, "I am faint." On regarding his countenance, it was not pale, but livid, almost black, and the muscles agitated by a convulsive motion. The respiration became deep, laboured, and stertorous, like that of apoplexy. The pulse being examined at the wrist, was found distinct, but very slow. The wound not bleeding, and very little blood having been lost, the temporal artery was opened, and the blood flowed from it with great freedom. As it flowed, the respiration became more frequent and less laborious—the pulse at the wrist more natural. The leaden colour in the cheeks assumed a reddish tinge, and the alarming character of the symptoms was evidently diminished. About twenty minutes elapsed during these changes. At the end of half an hour, it was thought safe to remove the patient to his bed, where he lay in a state of insensibility for two hours, at the expiration of which, he awaked as from sleep, still breathing like an apoplectic. The night was passed without any accident, and on the following morning he was as well as usual, with the exception of a moderate soreness over the thorax, and a headache.

In seven days after the accident described above, the operation was performed without tying the carotid artery.

The diseased parts were surrounded in an elliptical incision, extending from the lobe of the ear to the upper part of the neck, and including the submaxillary, the sublingual and parotid glands—all of them in a morbid and disorganized state, and they were all entirely removed. The hæmorrhage was copious, but readily arrested, with the exception of that from a large vein, which, from its depth, under the jaw, could not be distinguished so as to admit the application of a ligature, and was therefore compressed by a sponge. The veins below the wound were compressed during this operation. The patient experienced a slight faintness, which soon passed off. He had no bad symptoms; and on the 10th of December, the wound being nearly healed, he requested his discharge, which was granted.

Case II.—Nancy Bunker, of Trenton, in Maine, married, her age 33. Three years since, she noticed a hardness in the right breast, which increased till it involved the whole gland in a tumour, very hard, movable, yet connected with the pectoral muscle by a morbid adhesion. The nipple is drawn in. The axilla is occupied by a considerable tumour, of a globular form, and quite hard. An operation was performed on the 24th Dec. 1831.

The patient sat in a chair. The right arm was extended, raised above a horizontal line, in order to give tension to the skin, and permit access to the arm-pit—and was supported in this position by an assistant. The skin on the surface of the breast, with the diseased nipple, were included in an oval incision—the breast was dissected from the pectoral muscle, and left connected with the axillary glands while the extirpation of these glands was effected. As they adhered to the great axillary vessels, they were cautiously detached by dissection, and by insinuating the finger where the cellular substance was loose, between the tumour and the great vein. This separation was nearly effected—only a slight connexion still existing at either extremity of the tumour. Proceeding to separate it, at the outer part of the axilla, a vein was divided and a small quantity of venous blood discharged. Scarcely was this done, when the patient struggled, her complexion changed to a livid colour, and at the same instant the bubbling or clucking noise, which had not been noticed before, was heard, though indistinctly; but the place from which it issued was not visible, the surrounding skin and fat lying over it. On this, the axilla was immediately compressed. The patient became insensible, breathing as in apoplexy. The tumour was at once separated. The posture of the patient was changed, and she was supported by those around. Some brandy was poured down the throat, and ammonia introduced into the nostrils. The pulse, however, became less distinct every instant. Cloths dipped in hot water, were thrown over the extremities. Strong frictions were applied to the chest and to all parts of the body. Considerable quantities of brandy were again poured down the throat. At this moment, the livid colour of the cheeks gave place to a suffusion of vermilion red—and no glow in the cheek of a youthful beauty, ever gave one so much pleasure as that flush. But the flush soon passed off: the lividness reappeared; the respiration became more feeble; pulse at the wrist scarcely perceptible: and notwithstanding the redoubled applications of external heat and moisture, the extremities and the whole body cooled rapidly, and presently the respiration ceased.

As a last effort, the larynx was opened,

and the inflation of the lungs, by a bellows, was put in operation in a speedy and perfect manner, imitating the movements of inspiration and expiration with great exactness—continuing, at the same time, the general application of heat and frictions to the whole surface. These measures were employed for about twenty minutes longer. At the end of this time, there was no remaining hope of the restoration of the patient to life. The friends being anxious to take advantage of a vessel then sailing for their home, the body was soon after removed, and no opportunity afforded for examination.

The fact of the introduction of air into the veins, during surgical operations, may be viewed as being established by abundant evidence. It must, therefore, be a matter of importance to surgery, to prevent and to remedy so formidable an occurrence. To throw some light upon the subject, we shall consider, 1. The manner in which air gains admission into the veins, in surgical operations. 2. The mode in which it influences the functions and causes death. 3. The means of prevention. 4. The remedies to be applied when the accident has occurred.

1. *The manner in which air gains admission into the veins.* In order to understand this, two things are to be considered—the state of the heart, and that of the affected vein. First, the heart. This organ has a dilating, as well as a contracting power. The auricles, after contracting, dilate by an active motion, and suck the blood from the neighbouring veins. By this suction of the right auricle it is, that air may be drawn in at the opening in the wounded vein. Second, the condition of the vein is to be regarded. The coats of the veins are flaccid; and in their ordinary state, an attempt to suck in air at any aperture, would be followed by a collapse of the walls of the vein, and the introduction of air in this mode would be impossible. But if the coats of the vein are prevented from collapsing, by an adhesion to an unyielding substance, air might be sucked into it and through it, without any difficulty. If a suction-hose were composed of a thin skin, water could not be drawn through it; but if it were covered with metal to which it adhered, there could be no obstacle to the suction process. In order that air may be sucked into a vein, in the living body, its coats must be prevented from collapsing, and this may be done by different causes. First, by position. If the arm, for example, be extended to the utmost degree, the axillary vein will, at the time, be in a state of tension; and should an aperture be made in it, in that situation, the vein could not collapse, and air might be drawn in. Second, if the vein passed through and adhered on the outside, to a firm tumour, the vessel could not collapse. Third, the same result would be produced by an attachment to surrounding fascia, which is again attached to bone. Other causes might produce the same effect; as, the situation of a short vein between two others, with each of which it is connected—the situation, for example, of the transverse jugular veins, which pass across from the anterior to the middle jugular. When such conditions of the veins near the heart are taken into view, together with the suction power of the right auricle, there seems to be no difficulty in explaining the entrance of the air into the vein and the heart.

2. *The mode in which air introduced into the circulating system, causes a derangement of the vital functions*, is not so satisfactorily explained.

The organs whose functions have been supposed to be specially deranged, are the lungs, the brain, and the heart. The *lungs* have been found to contain air in their sanguiferous vessels; and as the phenomena bear a resemblance to those of asphyxia, this organ has been supposed to be the primary seat of derangement. The livid appearance of the skin, also, and the gurgling noise in the chest, seem to indicate an affection of the lungs; but the latter symptom arises merely from the passage of air through the blood of the heart and of the lungs; the former, from the imperfect state of the circulation. The *brain*, by others is believed to be affected by the introduction of air into its blood-vessels. Bichat produced appearances in animals, similar to those from this accident, by injecting air into the carotid artery; and in our own cases the privation of sensibility, the slowness of the pulse, and the heavy respiration, appeared to indicate pressure on the brain. It has been said that the time is not sufficient for the imbibed air to reach the brain; but there is a sensible interval between the entrance of the air and the occurrence of the phenomena—an interval quite sufficient for the air to pass through the right side of the heart, the lungs, the left side of the heart, and the carotid arteries, to the brain. In examinations of the bodies of some of the victims of this accident, air has been found in the right auricle of the *heart*. This fact, taken in connexion with the slowness or total failure of the pulse, has been thought to prove that the

great organ of the circulation is the principal seat of disorder. The experiments of NYSTEN favour this explanation, and seem to show that the distension of the heart by the air is sufficient to account for the fatal effects of the introduction of that fluid into the veins. (See *Bibliography* to this section.)

3. *Means of Prevention.* The veins most likely to be the seat of the accident, are those near the heart, viz.—the anterior, middle, and posterior external jugular veins; the internal jugular, subclavian, axillary, and their collateral veins. The external iliac; and even the saphæna, when in an enlarged and indurated state, may also become so. When surgical operations are performed in the vicinity of these vessels, or when they are to be wounded necessarily, the operator must bear in mind the danger, and adopt the following cautions. 1. He will avoid implicating the veins named above, until the latest period of his operation, in order that he may have a better opportunity of compressing them. 2. He will, if possible, cause such veins to be compressed between his incisions and the heart. 3. When he sees a stream of black blood issuing under his knife, he must suspend his operation till he has ascertained whether air is drawn in. 4. The instant he perceives the peculiar sound of air passing through a narrow aperture, he makes compression on the wounded part, and abandons the operation unless he is able to compress the vein between the wound and the heart. 5. In dissecting near those veins, he must avoid that posture which gives strong tension to the vein. In the axilla, for example, if the axillary vein happens to be wounded while the arm is extended and elevated, air may be drawn in; but if the vein is wounded when not in a state of tension, air will not enter. 6. When the operator is compelled to divide any of those veins, he desires the patient to make a full inspiration before his incision.

4. *Treatment.* If, during an operation, the patient faint, the surgeon must carefully attend to his condition, and, comparing his symptoms with those of ordinary syncope, make himself certain of the nature of the affection; for the air may have been admitted without his notice. When he has satisfied himself on the subject, he proceeds as follows. If the pulse is slow and suffocated, the patient not having lost much blood, the temporal artery is to be opened, and blood abstracted, varying in quantity according to the effect of the abstraction. On the other hand, if much blood has been lost, and the pulse is very low, stimulants must be employed. Cold water is to be dashed in the face, and ammonia applied to the nostrils; and if the patient can swallow, this medicine is to be taken into the stomach; if not, it must be thrown in by a syringe. Frictions must be applied to the extremities; and blankets, wrung out of hot water, to every part of the body. Should these means fail of success, artificial respiration must be resorted to, by introducing a tube into the glottis, or through an aperture between the thyroid and cricoid cartilages. When no better instrument is at hand, common bellows may be used. The efforts should be continued long and steadily—say from half an hour to an hour. An attempt to pump the imbibed air from the heart, through the internal jugular vein, by means of a syringe, is an operation that cannot be recommended, since it appears more likely to allow the entrance of a further quantity of air, than to abstract that already admitted. A proposal which at first view may seem scarcely more plausible than that mentioned, might be made with some hope of advantage. The introduction of a liquid into the veins, has been often attended by the revival of the patient, in cases of cholera, though rarely with ultimate success. In this accident, the vital powers not having received that lesion which is the result of an exhausting disease, it may be hoped that a successful revival might sometimes be effected, by the injection of the saline solution into the veins.

J. C. WARREN.

BIBLIOGRAPHY.—WEPFER is said to be the first who recognized the fact of the insufflation of air into the veins producing instantaneous death. It is stated that he killed an ox of stupendous size, by only inflating, with his mouth, the jugular vein of the animal. This experiment was subsequently repeated by others, and upon various animals. A summary of all the observations made upon this subject previously to the time of MORGAGNI, is given in the invaluable work of this writer, *De sedibus et causis morborum*, Epist. V. § 21, et seq.

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BICHAT. *Recherches physiologiques sur la vie et la mort.* Paris, 1800. p. 208, et seq. of the 4th ed. with notes by Majendie. Paris, 1822.

NYSTEN, (P. H.) *Recherches de physiologie et de chimie pathologique*, &c. Sect. 1. Paris, 1811. The numerous experiments of this author, made with the greatest care, clearly prove, that air injected into the veins of animals produces death, by excessively distending the parietes of the right cavities of the heart, and thus prevent-

ing their contraction so as to propel the blood which they contain, into the lungs. Such is the result of the sudden injection of a large volume of air into the venous system. But if this fluid be introduced in small quantity and gradually only, the sole derangement of the circulation produced, is a momentary excitement of the action of the heart: this excitement, when the injection of air in small volume is repeated, is followed by a depression of the same action, as is proved by the weakness and slowness of the pulse. If we continue thus to inject gradually a large quantity of air into the venous system of a living animal, severe primary symptoms are not produced; but this fluid occasions consecutively a lesion of the pulmonary tissue, (probably emphysema,) whence result cough, expectoration of a ropy, transparent, frothy liquid, more or less distinct rhonchus, and death. These symptoms may be thus prolonged until the third day; before the animal dies. Then death commences in the lungs; and in this case, as in the other, the brain is never primarily affected. Finally, an experiment of Nysten tends to prove that when air is injected at different times into the jugular vein, and in so small a quantity as not to arrest the action of the heart, it changes the bright arterial colour of the blood into a brown, which becomes darker in proportion as the injection is prolonged. *Dict. de Méd.* II. 67.

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Leroy d'Etiolles. *Note sur les effets de l'introduction de l'air dans les veines.* Archiv. Gén. de Méd. III. 410. Paris, 1823. The author ascribes the death in these cases to asphyxia caused by emphysema of the lungs.

Sansom. *Mém. lu au nom de M. Dupuytren, a l'Acad. Roy. de Méd.* Archiv. Gén. V. 430. Paris, 1824. This memoir contains the details of an operation by M. Dupuytren, for the extirpation of a fibrous tumour from the posterior and lateral part of the neck of a young girl; and in which air entered into the veins, causing death.

Piedagnel. *Recherches anatomiques et physiologiques sur l'emphyseme du poumon.* Journ. de Phys. Expérimentale. IX. 60. Paris, 1829. This author and M. Leroy maintain, that death, in cases of the accident under notice, is not the result of the sudden interruption to the circulation caused by the accumulation and rarefaction of the air in the right cavities of the heart, but of emphysema of the lungs.

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Legallois. In Journ. Hebdom. de Méd. III. 183. Paris, 1829. This experimentalist has observed three instances in which the air penetrated into the inferior vena cava and the heart, by the uterine veins, causing instant death in female animals, in which he was studying the effects of abstinence and of the loss of blood. Is it to a cause of this kind, inquires M. Ollivier, (*Dict. de Méd.*) that we should attribute the sudden and unexpected death of recently delivered women, whose labour has been painful, and in whom, on post mortem examination, nothing is discovered to account for the catastrophe?

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Clemot. In La Lancette Française, Nov. 30, 1830. M. Clemot has several times, in operations upon the upper part of the body, encountered the accidental entrance of air into the veins. 1st. In dissecting out a tumour from the axilla, a singular sound of blowing or of aspiration was heard, leading the assistants to believe that the thorax had been penetrated: the patient uttered violent complaints, and fainted; but revived after a time. A ligature was applied to the vein by which the air penetrated. 2d. In applying a ligature to the subclavian artery, a small vein was opened, when a slight but distinct sound of aspiration was heard. M. C. put his finger upon the vein, and the sound ceased; he removed his finger, the sound was renewed He repeated this experiment several times, which proves, in accordance with former experiments, that the entrance of more than a single bulb of air into the veins is necessary for the production of death, as Bichat asserts. A ligature was placed on the vein, and no injury was experienced. 3d. In the extirpation of a tumour from the breast, air entered into the veins. The patient died a few hours after the operation. On examination. the veins going from the wound to the heart, the auricle and right ventricle, were found distended with air.

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Puydebat. *Ablation d'une tumeur; entrée de l'air dans les veines*, &c. Journ. Univ. et Hebdom. XI. 165. Paris, 1833. The subject of this case was a girl, 18 years of age, with a strumous tumour at the upper and lateral part of the neck, operated upon by M. Roux. Whilst the operator was dissecting out the tumour, a sound was suddenly heard, similar to that made when air is admitted into an exhausted receiver: the patient screamed. became violently agitated, and life appeared extinct; she revived, however, after some minutes, and no bad symptoms appeared until the morning of the seventh day, when she became oppressed, comatose, and expired at night. M. P. thinks that an additional quantity of air, at this period, entered the vein. On dissection, it was found that the internal jugular had been cut transversely. The lungs were crepitant. Air was found in the aorta, and a small quantity of it in the iliacs; the heart was empty; no air was found in the arteries at the base of the brain.

Pigeaux. In Gaz. Méd. No. 38. March, 1833. Dr. P. is of opinion that the entrance of air into the veins is not the sole cause of death. The grounds of this opinion are by no means conclusive.

I. H.

§ 2. *Action of air introduced into the arteries.* No very appreciable ill effects result from the injection of air into the ar-

teries, unless this fluid passes into the veins or is conveyed to the brain. If a considerable volume of air be forced into an artery, the femoral for instance, so that it enters into the veins and reaches the heart, precisely the same phenomena are produced as when this fluid is originally injected into the latter vessels. But when the air is conveyed to the brain in any quantity, as by its introduction into the carotids, phenomena of a different character result. Bichat asserts that air on reaching the brain proves fatal; in what manner, he is unable to explain, but he denies that it is by compressing this organ. (*Recherches Phys.*, &c. 4th ed. p. 270.) It appears, however, that in minute portions air is quite innoxious to the brain, (*Dict. de Méd.* II. 74.) and that it proves injurious, only when a considerable volume of it reaches that organ; and the experiments of Nysten most conclusively demonstrate that then it produces all the phenomena of apoplexy, and that death does not take place for several hours. (*Recherches de Phys.*, &c.) The testimony of Majendie is to the same purport. If we propel, says he, towards the brain, by the carotid artery, a considerable quantity of air, symptoms of violent congestion of the brain, spasmodic rigidity of the muscles, loss of sensibility and of the use of the senses, all the phenomena of true apoplexy, are instantly observed. Respiration and circulation are for a time unaffected, but these two functions ultimately become impeded, and death ensues. Every phenomenon leads to the belief that the alteration in the circulation of the brain depends here upon the presence of air rarefied in the ultimate arterial ramifications. When apoplexy is thus produced, if the injection of air be continued and with force, the small vessels are ruptured, this fluid diffuses itself into the parenchyma of the brain, which it renders emphysematous and crepitant. Finally, a portion passes into the veins and reaches the right cavities of the heart, and thus assists in arresting the circulation. (Note to Bichat's *Recherches*, &c. p. 269.) I. H.

§ 3. *Action of air upon the cellular tissue.* The introduction of air into the cellular tissue is not productive of any irritation of that structure. Sir Astley Cooper (*Lectures by Jones*, p. 44.) states that he passed a trochar through the skin of a dog, and inflated the cellular membrane, without any appearances of inflammation having followed. Similar experiments were made by Dr. J. K. Finley, and with the same result. He forced into the cellular tissue of a cat, by means of a gum elastic bag attached to a silver tube, a large quantity of dry air. "The distension was so great as almost to prevent locomotion for a short time; but the air gradually diffused itself through every part of the cellular structure, and in four or five days was entirely absorbed, without producing any other inconvenience. This has been repeatedly tried on different animals, and always with the same results." (*North Am. Med. and Surg. Journ.* III. 262.) The perfect innoxiousness of air to the cellular tissue is further conclusively demonstrated by that common accident, emphysema, in which, the infiltration of air causes no inconvenience, other than that which depends upon its particular seat, or which results from the distension and swelling. After the air is removed, no pain, or any trace of the previous presence of this fluid, is to be found. I. H.

§ 4. *Action of air upon serous membranes.* From considering the much greater degree of inflammation, pain, and danger, which attend compound than simple fracture and luxation, with the danger which attends wounds penetrating into the cavities of the head, chest, or belly, Monro was led to infer, "that the bad symptoms were much more owing to the admission of the air than to the mere division of the solid or membranous parts;" and in this opinion, says he, "I was much confirmed by a great number of experiments I made on living animals at different times, and particularly in the year 1771; in which, with various views, I laid open the cavities of the thorax and abdomen: for in these I found that the danger was not proportioned to the size of the wound inflicted, but to the time and manner in which the bowels were exposed to the air." (p. 39.) He further states that "in one experiment on a pig, the inflammation from the admission of air by a small incision, was so violent as to kill the animal, after producing an adhesion of the lungs with the upper part of the pleura, in the space of thirty-six hours." Mr. John Bell directed against this opinion the keen shafts of his criticism, and its incorrectness has since been conclusively demonstrated by the results of penetrating wounds of the chest and abdomen, as well as by the experiments of Physick, Astley Cooper, Nysten, Williams, John Davy, and Finley. Upwards of forty years ago, (in 1790,) Dr. Physick, in order to ascertain the correctness of Monro's views, injected air into one side of the thorax of a kitten, through a small puncture; the animal suffered little in-

convenience, and when killed on the fourth day "not a vestige of inflammation was observable." (DORSEY'S *Elements of Surgery*, 2d ed. p. 80.) Similar experiments were subsequently performed by Sir ASTLEY COOPER, (ABERNETHEY'S *Surg. and Phys. Essays*, p. 55.) Dr. JOHN DAVY, and Dr. FINLEY, with precisely the same results. Dr. DAVY inflated the right pleura of a dog with atmospheric air; at the end of forty-eight hours the dog was killed, when the wound was found closed by coagulable lymph, and the pleura "free from inflammation." (*Philos. Trans.* 1823. p. 500.) All these experiments concur in proving that when air is injected into the pleura, it is partially or wholly absorbed, without producing the slightest symptom of inflammation; and those of Dr. DAVY further show the curious fact that the oxygen is absorbed in greater proportion than the azote.

The results of surgical observations and of direct experiments, equally demonstrate the innoxiousness of the air to the peritoneum. The effects of the exposure of this membrane to the air, in penetrating wounds of the abdomen with expulsion of some of the intestines; in the operation of hernia; in the Cæsarian section; in the extirpation of the ovaria as practised by Dr. M'DOWELL, of Kentucky, and Mr. LIZARS, of Edinburgh; and finally, the experiments of Sir ASTLEY COOPER and of Dr. FINLEY, who injected air into the abdomen of animals without any inflammation resulting, may be adduced in confirmation of this position. Prof. THOMPSON, who advocates the opinion of the stimulating property of air, ascribes this property to the oxygen which enters into its composition. To ascertain whether this gas alone was capable of exciting inflammation in serous membranes, Dr. FINLEY repeated his experiments with this gas, and without the animal giving any evidence of suffering—or the pleura, peritoneum, or cellular tissue, exhibiting any marks of inflammation.

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I. H.

§ 5. *Action of air on synovial membranes.* The similarity in the organization of the serous and synovial membranes, would seem to justify the inference that air is as innoxious to the latter as we have seen it to be to the former. Such, however, is not the opinion generally entertained. MONRO taught that air was an active irritant to that tissue; and this doctrine has since been received by most surgeons, without, it appears to us, a sufficient examination, and in opposition to some well-determined facts. No positive experiments, so far as we know, can, it is true, be cited in contradiction; but clinical observations certainly afford no positive evidence in its support. Very severe symptoms, it must be admitted, often arise from the exposure of a joint; but may not these with more justice be referred to the circumstances which attend the injury, the nature of the wound, improper treatment, &c., than to any irritating properties of air? In favour of this opinion, many instances might be adduced. Dr. BOND relates a case in which "the patella was cut across transversely by a blow of an axe, and divided into two nearly equal portions, so that the joint was laid open," and Dr. B. "had a direct view into it. The patient was a healthy boy, aged eight years, and the fragments of the bone united without any apparent affection of the synovial membrane." (*Philad. Journ. Med. and Phys. Sciences.* II. 273.) Other instances in which joints have been freely opened without any bad symptoms accruing, might be cited; whilst on the contrary the most violent effects have often resulted from injuries of joints in which the wound was too small to admit the passage of air. It thus appears, that the possession, by this fluid, of any property by which it is enabled to excite irritation in synovial membranes, remains as yet to be proved; though it will scarcely be denied that a current of air may prove injurious to these membranes, by its temperature, when this last is different from that of the tissue; or by absorbing the moisture of the parts, and thus placing them in an unnatural condition: such would also be the case with serous tissues.

I. H.

§ 6. *Action of air introduced into the*

alimentary canal. A certain portion of air is always introduced into the stomach with every article of food or drink that is taken. This fluid may be even swallowed in such quantity as to distend the stomach and bowels. Majendie has seen air thus accumulated in the stomach and intestines, to such an extent as to produce considerable tympanitis, with hiccup, efforts to vomit, general convulsions; and all these symptoms cease immediately, without the slightest inconvenience remaining, upon the air being discharged. All the ill effects were consequently due to the distension arising from its mechanical action, and not from any irritating property. Piorry has shown that air introduced into the intestines may cause such a distension of the abdomen as to produce asphyxia as promptly as if injected into the trachea. (*Dict. de Méd.* II. 78.)

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Bouvier. *Mém. sur lo déglutition de l'air,* &c. In Nouv. Biblioth. Méd. III. 21. Paris, 1826.

I. H.

§ 7. *Action of air on mucous membranes.* The buccal, nasal, and pulmonary mucous membranes, are naturally destined for exposure to the air, and of course it is innoxious to them; nor do the other membranes of this class not ordinarily subject to the contact of that fluid, appear to suffer irritation from its direct action; nevertheless, when these last are long exposed to it, that fluid, by removing from those tissues their natural moisture, contributes to effect a change in them, rendering their aspect and character similar to those of the external tegument. Examples of this are furnished in some old cases of prolapsus uteri, or of the membrane of the vagina, &c. This influence of the air is so striking that Hebreard was led to believe that the contact of the air upon the skin constituted the sole difference between the external and internal tegument; a notion certainly a little extravagant. (*Mém. sur l'analogie qui existe entre les systems muqueux et dermoid.* In Mém. de la Soc. Méd. d'Em. VIII. 153.) I. H.

§ 8. *Action of air on wounds and ulcers.* The exposure of recent wounds and ulcers to the air does not ordinarily excite any painful sensation; but this fluid may become a source of great irritation by its difference of temperature and by removing from injured parts their natural moisture. Ambrose Pare long ago pointed out the injurious influence of cold air upon wounds, and the recent experiments of Guyot (*Journ. Hebdom.* IV. 276.) would seem to show that it is principally by its temperature that the air produces irritation of the tissues. This subject will be more properly discussed elsewhere. (See *Wounds.*) The manner in which the air proves irritating by removing the natural moisture of wounds, has been fully exposed by Dr. Bond.

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I. H.

ALA. (*Anat.*) A wing. This epithet is bestowed by anatomists to certain parts supposed to bear some resemblance in form to a wing. I. H.

ALBINO. (From *albus*, white.) *Leucæthiops*, *Æthiops-albus*, Lat.; *Nègre-blanc*, *Blafard*, Fr.; *Kakerlake*, *Nachtmensch*, Germ. Individuals are so denominated, whose skin is perfectly colourless; their hair of the colour of cotton or silk, or pale flaxen; their irides of a pale rose tint; and their pupils red. Such persons have also received various local appellations; thus, they are called *dondos* at Loango, *bedas* in Ceylon, and *chacrelas* in Java, &c.

Various hypotheses have been offered in explanation of the causes of albinism; as, that it results from some disease, as cachexy, leprosy, &c., from the action of heat, the privation of light, that albinos are a distinct species, &c.; none of which are satisfactory. The labours of the anatomists have been more successful; they have shown it to be a vice of conformation, arising from an arrest of development. It is known that the colour of the skin, in negroes, depends upon a matter secreted in the rete mucosum. Blumenbach was of opinion that this tissue does not exist in albinos, and this supposition has been demonstrated to be correct, by Buzzi, of Milan, who examined a peasant, 30 years of age, an albino, who died in the hospital of that city. This anatomist states that he found the skin detached from different parts of the body, divested of rete mucosum, and that he could not discover the least vestige of it on maceration, even in the wrinkles of the abdomen, where it is generally most abundant and most visible. The eyes were also destitute of pigmentum nigrum, both behind the iris and under the retina; within the eyes there was found only the choroid coat, extremely thin, and tinged of a pale red colour by vessels filled with discoloured blood. It is to be remarked, however, that it is extremely difficult to detect the rete mu-

cosum when it contains no colouring matter, as it may then be confounded with the subjacent chorion; and hence M. Breschet thinks that further observations are requisite before we can determine positively whether or not the rete mucosum be entirely absent in these cases. This distinguished anatomist is further of opinion, that in albinos there is rather a derangement than cessation of the secretion of pigmentum nigrum; as he has frequently discovered, on examining animals presenting this organic deviation, melanose tumours; whence he concludes that the colouring matter of the skin and choroid thus find an emunctory. M. Breschet has seen two albinos, one a man, the other a woman, who presented the usual peculiarities of such persons, except that they had blue eyes and a bluish skin. This is a state of incomplete albinism. The eyes of albinos appear red in consequence of the absence of the pigmentum nigrum; these organs being in them in the same state as those of fœtuses in the early periods of their existence. The secretion of the pigment does not take place until a short time before birth and some time after the eye is perfectly formed. When this secretion first commences, it gives the eyes a bluish colour.

Albinos are said to be most common in Africa, but they have been found in every part of the world. Like other vices of conformation, albinism may become hereditary. M. Blandin states, on the authority of a friend, that there is a whole family of albinos residing at Choisy-le-Roy. Sometimes only certain members of a family inherit the organic deviation. Thus, Winterbottom (*Account of the native Africans*, &c.) states that in one family, the mother a negress, the father an African albino, three of the sons and two of the daughters were black, and two daughters were albinesses; and that an African albiness, whose father, mother, brothers, and sisters, were all black, married a negro and had a black child. M. Buzzi states that a woman of Milan had seven sons; the two eldest had brown hair and black eyes; the three next had white skins, white hair and red eyes; and the two last resembled the two eldest.

Albinos are generally of moderate size, slender in person, short-lived, of weak character, and feeble intellect; though the reverse is said sometimes to be the case. Jefferson asserts that all those he met with, were well formed, strong, and healthy. Owing to the absence of the pigmentum nigrum of the eye, a bright light is offensive to these persons, and their eye-lids acquire a constant motion, as do likewise their irides, which appear in a state of rapid and constant oscillation, opening and contracting the pupil. Vision is in albinos most perfect in a moderate light, as at twilight or in moonlight; then they see better than other persons.

Albinism is not confined to the human species; examples of it are found in mammalia and birds. Tiedemann, in his Zoology, enumerates a number of species of animals in which it has been observed.

There is a form of albinism which is partial, or affects only portions of the body. This consists generally in a state of disease, probably a defective nutrition, an atrophy of the rete mucosum, or a suspension of secretion of pigmentum nigrum. Instances of this variety have been described by Morgan, Rush, and others.

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I. H.

ALBUGINEA. (From *albus*, white.) A term adopted by anatomists to designate certain membranes characterized by being perfectly white, and of considerable consistence; as, the tunica albuginea testis, the proper tunic of the testis; tunica albuginea oculi, or sclerotica, &c. Some anatomists have applied this term to the aqueous humour. I. H.

ALBUGINEOUS FIBRE. *Fibre albuginée.* This epithet has been applied by CHAUSSIER to the fibre which constitutes the base of the textures denominated by BICHAT, the Fibrous system.

The albugineous fibre is white, linear, cylindrical, tenacious, renitent, but little elastic or extensible, very resistant, insensible, and without contractility. It is disposed in fasciculi or fasciæ, of greater or less size, and forms, with the vessels and cellular tissue, 1. the albugineous *membranes*, as, the periosteum, the dura mater, the sclerotica, the proper tunics of the testicle, spleen, kidney, &c.; 2. the albugineous *capsules* of the articulations; 3. the *sheaths* of the tendons; 4. the *aponeuroses*; 5. the *ligaments* of the articulations. The chemical composition of the tissue in question is nearly the same as that of the cellular tissue, and many anatomists, with apparent justice, consider the former as merely a modification of the latter. Mr. GRANGER states, that in order to ascertain how far the two substances resembled each other, he placed some pieces of ligament, of fascia, and of tendon, which are all formed of the albugineous fibre, in maceration. In the course of about three months, he found that they were reduced into a soft, pulpy kind of cellular membrane, having precisely the same appearance as the latter, when that is treated in the same manner. "From these and other observations," he remarks, "I have no doubt that the albugineous fibre ought to be enumerated as a product of the cellular, and not as an elementary structure." (*General Anatomy*, p. 61.) (See *Fibrous Tissue.*) I. H.

ALBUGINITIS. Inflammation of the albugineous tissue. (See *Fibrous Tissue, pathological states of*, and *Gout, Rheumatism*, &c.) I. H.

ALBUGO. (From *albus*, white.) A white cloudy or opaque spot on the cornea, produced by the deposition of coagulable lymph, the consequence of inflammation. Sometimes this lymph is deposited between the lamina of the cornea; at others, on its surface, by the cicatrization of an ulcer or wound. Many writers have restricted the term albugo to the former, and denominated the latter, leucoma. (See *Cornea, inflammation of.*) I. H.

ALBUMEN. (From *albumen*, Latin for white of eggs.) An azotized proximate principle, very abundant in animal matter, and occasionally found in vegetables. It constitutes nearly the whole of the white of eggs, which may be taken as a familiar example of it, and in which it is associated with a little saline matter, and a minute portion of free soda. Albumen is not to be viewed as an invariable principle, but rather as a term designating several principles, which present some shades of difference when compared with each other. Thus, *animal albumen*, which is always to be understood when the simple term is used without qualification, differs from *vegetable albumen*; and even considered independently of the latter, it presents a few points of difference, according to its particular animal source.

Albumen performs a very important part in the animal economy, and on that account has received a large share of attention from the chemist, physiologist, and pathologist. It is also a principal ingredient in nutritive animal substances, and is occasionally employed as a remedy. In the following account of it, we shall accordingly first speak of its general chemical properties, next of its physiological and pathological relations, and lastly of its dietetic and therapeutical applications.

Chemical Properties. Albumen, as an animal substance, exists under two distinct forms,—liquid and coagulated. *Liquid albumen*, as it occurs in the white of eggs, is a transparent glairy fluid, insipid and inodorous, and soluble in water. It is heavier than water, and greens the syrup of violets, in consequence of the presence of soda. When exposed in thin layers to a current of air, it dries and becomes a solid, transparent, yellowish, imputrescible substance, which, dissolved again in water, reproduces the liquid albumen with all its original properties. If kept in the liquid state, it first contracts an unpleasant odour, and finally putrefies. Liquid albumen is rendered more fluid by solutions of the alkalies and alkaline earths, and is not precipitated by the acetic or phosphoric acid; but it is coagulated by galvanism, by the mineral acids, by alcohol, and by heat, and is precipitated by several re-agents, even when present in very minute quantity. Its coagulation by galvanism was first ascertained by BRANDE, who found, upon passing a weak galvanic current through an albuminous fluid, that the albumen concreted round the positive wire. This effect was attributed by BRANDE to the transfer of the soda of the albumen to the negative pole, thus removing the alkali, to the presence of which he attributed the liquid state of the albumen; but it has been proved by LASSAIGNE that the effect does not take place in *pure* albumen, and occurs in ordinary albumen, in consequence of the decomposition of the common salt

which it contains, the soda of which passes to the negative pole, while the muriatic acid coagulates the albumen round the positive wire. When coagulated by the strong acids, a portion of each is found to have combined with the albumen. The manner in which alcohol acts in producing coagulation is not well understood. It is supposed by Dr. Bostock to depend probably on the power of the alcohol to abstract a portion of water.

The tests or re-agents which precipitate albumen are numerous, and some of them very delicate. Galvanic electricity, explained above, forms an elegant and delicate test of albumen in animal fluids. It is precipitated also by tannin, and by solutions of various metallic salts, among which may be mentioned the muriates of tin and gold, and the subacetate of lead. Corrosive sublimate, proposed by Dr. Bostock, is an extremely delicate test of liquid albumen; and ferrocyanate of potassa, according to Dr. Turner, is equally, if not more delicate, for the same purpose. The former, however, has the advantage of being most discriminative, as it acts upon no other animal substance, likely to be present in albuminous fluids, than the albumen itself. When the latter test is employed, it is necessary to neutralize the free soda of the albumen with a little acetic acid, otherwise it will not act. The several precipitates obtained by these different re-agents differ according to circumstances. When a salt is the precipitant, the precipitate usually consists of the metallic oxide of the salt, united with the albumen; but occasionally, where a supersalt is used, of the excess of acid and the albumen. In the case of corrosive sublimate, the precipitate formed, consists, according to Orfila, of the albumen united with calomel. If this statement be accurate, it follows that the corrosive sublimate is decomposed.

In all the cases above explained, in which albumen is brought to the concrete state, except where it is coagulated by alcohol, the re-agent employed combines with it either in whole or in part, and, therefore, the change might be called more correctly precipitation than coagulation. But it is far otherwise, when it is brought to the solid state by means of heat; for then it neither gains nor loses any thing, and remains of the same specific gravity as before. This remarkable change constitutes the proper coagulation of albumen, and takes place at about the temperature of 160°. It is now called *coagulated albumen*, and in this state, possesses peculiar properties, which require to be noticed under a distinct head.

Coagulated albumen, as obtained by heating the white of eggs and washing the coagulum, is a tasteless, inodorous substance, opaque and of a pearly white colour. It is somewhat heavier than water, and without action on test paper. When dried, it is converted into a hard, brittle, yellow, semitransparent substance, which, subjected to the action of water, softens, swells, becomes white and opaque, and regains its original appearance. Coagulated albumen is soluble in 7000 parts of water, (Chevreul), is scarcely soluble in ammonia, but readily so in the fixed alkalies, even in the cold. It is acted on differently by the different mineral acids. Macerated for a month with diluted nitric acid, it is converted into a substance having the leading properties of gelatin. (Hatchett.) Digested in strong sulphuric acid, it forms, as in the case of fibrin, a dark solution, which, by the cautious application of heat, assumes a beautiful red colour. (Dr. Hope.) This change does not always take place, the action of the acid being influenced by slight causes, not well understood. Concentrated muriatic acid dissolves it when pure, with the production of a fine blue colour; and with the generation of a purple tint, when the albumen contains a little colouring matter of blood. (Caventou and Bourdois.)

The way in which heat acts in effecting the coagulation of albumen, has not been explained. It is not by producing condensation, for the specific gravity remains unchanged; neither is it by abstracting water merely, since, when liquid albumen is dried in vacuo, it equally loses water, but retains its solubility. It has been proved further that there is no absorption of oxygen during the change, nor any addition to or subtraction from the albuminous particles, considered as such. These being the facts, the only conclusion that can be arrived at, is that adopted by Dr. Bostock, namely, that the particles, in the act of coagulation, undergo some change in their figure, whereby their relation to each other is altered, without being brought nearer together.

The description above given of albumen is to be taken as applying particularly to the white of eggs; but there are several varieties or modifications of this animal principle which deserve to be noticed. Thus the albumen of eggs is different from that of the serum of the blood; and both these from the condensed coagulated albumen of which the albuminous mem-

branes chiefly consist. The chief differences between the white of eggs and the albumen of serum are the following:—Ether and the oil of turpentine coagulate the white of eggs, but have not the same effect on serum. When ether is agitated with serum and allowed to stand, it dissolves the fatty matter contained in the latter, and swims on its surface; whereas the white of eggs, similarly treated, is coagulated. Another point of difference is that the albumen of serum is more readily soluble in alkalies than the white of eggs.

A curious fact in regard to coagulated albumen, ascertained by BERZELIUS, is that its chemical properties are almost identical with those of fibrin. (See *Fibrin.*) The two substances are similarly acted on by acids and alkalies, and, in short, by almost all chemical agents hitherto tried; so that BERZELIUS feels disposed to admit that they are chemically identical, though differing in some adventitious circumstances, the precise nature of which is not yet known. The only chemical re-agent which acts differently on the two substances is the peroxide of hydrogen, (oxidized water,) which is decomposed by fibrin, but not by albumen. BERZELIUS, however, deems this no proof of an essential chemical difference between them; but as an indication merely of a different mode of aggregation of the particles.

Vegetable albumen possesses so many analogies to animal albumen, as to make it expedient to describe it in connexion with the latter. It exists, associated with starch and gluten, principally in the grains of the cerealia, and in the seeds of various leguminous plants used as food, such as pease, beans, &c. As obtained from these different sources, it presents unimportant differences in its properties. Vegetable albumen was confounded with gluten, until the difference between them was pointed out by EINHOF, who demonstrated that the matter called gluten by BECCARIA, consists in fact of gluten, properly so called, and another principle strongly resembling the white of eggs. In some grains the albumen is associated with an oil, as in the almond, the castor oil nut, hemp seed, &c.; a circumstance which fits these substances for forming an *emulsion;* that is, for affording a milky fluid, when rubbed up with water. Vegetable albumen possesses nearly the same properties as the corresponding animal principle. Like the latter, it is soluble in water, only in its uncoagulated state. When dried, it becomes opaque, and either white, gray, brown, or black. When allowed to putrefy, it first exhales the odour of old cheese, and afterwards that of putrefying animal matter, giving rise to ammoniacal products.

Animal albumen, kept in a moist state, undergoes putrefaction, and exhales sulphuretted hydrogen. Subjected to destructive distillation, it furnishes carbonate, acetate, and hydrocyanate of ammonia, a thick, fetid, and black oil, carburetted hydrogen, carbonic oxide, and nitrogen; and there is left a brilliant, bulky charcoal, difficult to incinerate. When burnt, after being washed and dried, it yields 1.8 per cent. of ashes, consisting of a large proportion of phosphate and carbonate of lime, a little soda, and minute traces of iron.

The ultimate composition of albumen has been determined by GAY-LUSSAC and THENARD, MICHAELIS, and PROUT. The results of their several analyses are so nearly coincident, as to create a confidence in their accuracy. According to the two former chemists, it consists in the 100 parts, of hydrogen 7.540, carbon 52.883, oxygen 23.872, and nitrogen 15.705. These constituents are to be considered apart from the ashes, already mentioned, and from a minute portion of sulphur, which always accompanies albumen, and gives to it the property of tarnishing silver vessels. Vegetable albumen has the same general composition, and, from this circumstance, has been called a *vegeto-animal* substance.

A different view of the nature of albumen from that here given, has been taken by M. RASPAIL, in a highly original work published at Paris, in 1833, entitled "*Nouveau Systeme de Chimie Organique.*" According to this chemist, albumen, as it exists in the white of eggs, when submitted to what he calls a *microscopical* analysis, evidently consists of two distinct parts; one, an insoluble cellular tissue, regularly organized,—the other, a soluble liquid, contained in the cells of this tissue. By destructive distillation, the liquid part yields abundant ammoniacal vapours, while the pure solid part scarcely furnishes a trace. From these and other facts, M. RASPAIL is of opinion that the nitrogen, obtained upon the elementary analysis of albumen, is exclusively derived from its liquid part, in which he supposes it to exist as an ingredient of the muriate of ammonia, and probably of other ammoniacal salts.

Physiological and Pathological Relations. Albumen, of all the animal substances, is the most diffused in the animal economy. United with water, it forms the serum of the blood, the liquor of the peri-

cardium, of the ventricles of the brain, and of the serous membranes generally, and the greater part of the synovia. It exists also in the chyle, lymph, and a numerous class of secretions, hence called albuminous. It is found also in a modified state in various animal solids; as for example, in the brain, in the membranes, in the cartilages of the nose, ear, eyelids, and trachea, and in those which tip the bones designed for motion on each other. During disease, the various serous cavities, as well as the cellular membrane, are liable, in consequence of inflammation, to contain a redundancy of fluid, which differs from the serum of the blood principally in containing less albumen. Of this character are the liquors of dropsies and of blisters; and the morbid parasitic productions, called *hydatids*, consist chiefly of albumen. In anasarca and other kinds of dropsy, the serous part of the blood appears to pass through the kidneys, and the urine, in consequence, becomes albuminous. The albumen, in most cases, may at first be detected in it by corrosive sublimate; but, in the progress of the complaint, it becomes so much more abundant, as to admit of its being precipitated by nitric acid, or even coagulated by heat. In this morbid condition of the urine, it is found that the urea diminishes progressively, as the albumen augments, until at last the former disappears entirely. The same state of redundant albumen and diminished urea is observed in chronic inflammation of the liver, in dyspepsia, and towards the termination of all hectic fevers.

Dietetic and Therapeutic Applications. From what has been said above, the reader is prepared to understand that albumen is highly nutritious. As an animal principle, it is constantly taken in with animal food, as the chief part of the juice and gravy of meat; and it is owing to its presence, along with other azotized or vegeto-animal principles, that bread constitutes so strong an alimentary substance. In acute diseases which require a low diet, food containing nitrogen should be avoided; and hence, albumen, whether vegetable or animal, would be hurtful. In such cases, the *non-azotized* vegetable principles, such as starch, under the various forms of *arrowroot*, *sago*, *tapioca*, &c., are most proper. Where, however, the condition of the system in disease or convalescence admits of the use of concentrated alimentary matters, albumen, as it exists in eggs before coagulation, and in the juice and gravy derived from the flesh of young adult animals, forms a very suitable food.

Albumen, in the form of white of eggs, (*albumen ovi*,) is sometimes employed in pharmacy for the suspension of insoluble substances, in forming mixtures; but for this purpose it is inferior to the yolk. The whites of two eggs, coagulated by a drachm of alum, forms the *cataplasma aluminis*, or alum cataplasm, of the Dublin Pharmacopœia, which is employed, inclosed between folds of cambric, as an astringent application in certain states of ophthalmia. But the most important therapeutic application of albumen is as a counterpoison to the effects of the soluble salts of mercury and copper, with which it forms insoluble compounds, inert in relation to the animal economy. When used in poisoning by corrosive sublimate, it acts by decomposing the poison, and forming with it an inert insoluble compound of albumen and calomel. (See *Corrosive Sublimate.*)

Albumen, as it exists in the white of eggs, is used in the arts, for the clarification of syrups. For this purpose it is boiled with them; and, by its coagulation, involves the undissolved particles, which it brings to the surface. Formerly the serum of bullocks' blood was much employed in the refining of sugar, and acts in the way just mentioned. White of eggs is also employed in refining wines and other liquids, in which case it acts without the aid of heat, being coagulated by the alcohol, the vegetable acids, or the tannin contained in the liquid clarified. In the laboratory, it is employed, mixed with lime, to form a very drying lute.

FRANKLIN BACHE.

ALBUM GRÆCUM. *Cynocoprus. Spodium Græcorum.* The white and friable excrements of dogs fed exclusively upon sheep bones and deprived of drink. It is composed almost entirely of phosphate of lime. This disgusting substance was formerly employed in medicine, but is now completely repudiated. I. H.

ALBUM NIGRUM. The excrement of mice and rats; formerly used both externally and internally as a remedy, but now very properly abandoned. I. H.

ALCOHOL. (From the *Arabic.*) *Alcool*, *Esprit de vin*, Fr.; *Rectificiter Weingeist*, Germ.; *Alcoole*, *Acquavite rettificata*, Ital.; *Alcohol*, *Espiritu rectificado de vino*, Span.

Alcohol is a peculiar, volatile, inflammable liquid, always a product of art, which is generated during the progress of a peculiar kind of fermentation, called *vinous*, *spirituous*, or *alcoholic*.

When certain vegetable juices and infusions are subjected to a proper temperature, they undergo peculiar intestine changes, with the extrication of gaseous matter, and acquire a vinous taste, which is derived from the production of more or less alcohol. All the liquids susceptible of this change are found uniformly to contain sugar, or some substance capable of being converted into sugar; and after the fermentation is over, the sugar is found to have disappeared, and the only new products are the alcohol, which remains in the liquid, and carbonic acid, which is the kind of gaseous matter evolved. These facts would naturally lead to the conclusion, that the elements of the sugar had been converted into alcohol and carbonic acid; and it will be seen in the sequel, that the comparative composition of the substances concerned, confirms the correctness of this conclusion.

Saccharine matter, though essential to the production of the vinous fermentation, cannot undergo the process by itself. It requires to be brought to the liquid state by water, and the solution, thus formed, to be subjected to the action of a ferment, and maintained at a sufficiently high temperature. Accordingly, the presence of sugar, water, and a ferment, and the maintenance of an adequate temperature, may be deemed the essential conditions for the production of this species of fermentation. The precise way in which the ferment acts, in commencing the reaction in which the fermentation consists, is not well understood. Neither has it been certainly ascertained whether the ferment is a peculiar principle of invariable composition, or whether the power of inducing the vinous fermentation is possessed by several principles. Nitrogen, however, appears to be a constant ingredient in the matter which possesses this power. The proper temperature for commencing and maintaining the changes, ranges from 60° to 90°.

Certain vegetable infusions, which naturally contain no sugar, but abundance of starch, are nevertheless susceptible of the vinous fermentation. This seeming exception to the general rule of the indispensableness of sugar to the process, is explained by the fact, that in such infusions when sufficiently heated, the starch becomes converted into sugar. This conversion was proved to take place, by Kirchoff; and the series of changes which occur, have been distinguished by the name of the *saccharine fermentation*.

Alcohol, being the product of the vinous fermentation, must necessarily exist in all *vinous liquors*, a generic term, which is to be understood as including all liquors, how various soever in other respects, which have undergone the peculiar fermentation here described. Formerly, however, it was supposed that the vinous fermentation produced a peculiar intoxicating liquor, not containing alcohol ready formed, but capable of yielding it by distillation, in consequence of a new arrangement of the particles. It was Mr. Brande who first disproved the latter idea, by showing that alcohol may be separated from vinous liquors by pure chemical means, without resorting to distillation. His method of proceeding consists in first precipitating the colouring matter by subacetate of lead, and afterwards absorbing the water by means of carbonate of potassa.

Very erroneous views are commonly entertained as to the precise import of the term *vinous liquors*. Speaking in the chemical sense, every liquor which has undergone the fermentation resulting in the formation of alcohol, is a vinous liquor; and according to this definition, not only wine, but cider, perry, porter, ale, and beer, are all vinous liquors. Sometimes the three latter beverages are called fermented liquors, under the erroneous impression that the epithet exclusively belongs to them. The proper term, however, for all these intoxicating liquors, before they have undergone distillation, is *vinous* liquors. They may, without inaccuracy, be called fermented liquors; but this designation is not distinctive of the class, inasmuch as it is so broad as to include vinegar, which also is a product of fermentation, though of a different kind from the vinous.

Alcohol, as generated during the vinous fermentation, exists in the liquid which has undergone the change, diluted to a greater or less extent with water, and associated with colouring matter, volatile oil, extractive, and, for the most part, certain acids and salts; their number and nature being dependent upon the character of the liquid employed. In order to separate it in the first instance, distillation is resorted to, which, though it does not form the alcohol, affords the readiest means of obtaining it apart from the greater portion of the water, and most of the foreign substances, with which it is associated in the original vinous liquor. The distilled product in these cases forms the different varieties of ardent spirit, distinguished by different names, according to their source. Thus, the distilled product obtained from

wine is called *brandy;* from fermented molasses or solution of sugar, *rum;* from cider, malted barley, or rye, *whiskey;* from malted barley and rye-meal with hops, rectified from juniper-berries, *Holland gin;* from fermented rice, *arrack;* &c. All these distilled liquors have peculiarities of flavour and colour, and are more or less strong, that is, contain more or less alcohol, according to the nature of the material from which they may have been obtained, and to the greater or less care with which they are distilled. Their strength, or richness in the alcoholic constituent, is conveniently judged of by their specific gravity, which is always less in proportion as this constituent is in larger amount. When the spirit has attained the density of 0.920, it is called *proof spirit;* and according as its specific gravity is less or greater than this, it is said to be *above* or *under* proof. The average strength of the "*diluted alcohol*" employed in pharmacy, corresponds with that of proof spirit.

Having obtained, as above explained, proof spirit, the chemist is still far from having procured the *pure* alcoholic ingredient of the vinous liquor; for this spirit contains half its weight of water, and is modified by the presence of volatile oil, which gives it a peculiar flavour, and of certain other foreign matters. In pursuing the purification, the next step is to subject the spirit to a new distillation, called *rectification.* By this measure it is freed from a portion of water, and at the same time from other foreign matters, whereby it is strengthened and purified; and at this stage of its purification, the alcohol, without reference to the vinous liquor which may have been its source, presents almost precisely the same properties. It is now called *rectified spirit*, being the *alcohol* or *spirit of wine*, of commerce. Whiskey is the spirit exclusively employed in this country for rectification, and will be found to furnish, on an average, 60 per cent., by measure, of rectified spirit, of the specific gravity of 0.835.

The separation of alcohol, in a state approaching to purity, by distillation and rectification, depends upon the simple principle of the greater comparative volatility of alcohol than of water; in consequence of which the former is enabled to rise in vapour at a lower temperature than the latter. Though this is the principle, yet much can be effected by the construction of the distillatory apparatus, in economizing the heat and abridging the labour. About the year 1805, a very useful apparatus, combining these advantages in a remarkable degree, was invented by M. Adam, a French distiller, of Montpelier. We are not informed whether this apparatus has been used to any considerable extent in this country; but as its mode of action is not generally understood in the United States, it may not be without its use to give a sketch of it for the information of the practical chemist, derived from the *Traité de Chimie*, of Thenard. The apparatus in question consists of a still, communicating by copper tubes with four large copper vessels, in a manner resembling that in which a retort is connected with several bottles in a Wolfe's apparatus. The liquid to be distilled is placed in the still and two first vessels, and is then made to boil in the still. By the vapours which come over into the first vessel and afterwards into the second, the contents of these vessels are successively brought to the boiling point. It consequently happens, that, in the third vessel, which contains no liquid, large quantities of alcoholic vapour arrive, mixed with the vapour of water. By keeping this vessel at such a temperature as merely to be able to condense a weak alcohol, it happens that the stronger alcoholic vapours proceed forward into the fourth vessel, from which, according to its temperature, vapours of proof spirit, or of rectified spirit, may be made to pass first into a worm surrounded by the vinous liquor employed, where they condense, and finally into another worm surrounded by water, where the condensed product is completely cooled. The liquor in the still being exhausted, is withdrawn by means of a stop-cock, and is replaced by the liquor in the first vessel, which is filled in its turn from the contents of the second; while this is replenished from the liquor around the first worm, which is then surrounded with a fresh portion of the liquid to be distilled. By the construction of the apparatus, it is evident, that rectified spirit may be obtained at one operation, that the distillatory process proceeds without interruption, and that the caloric is saved which is given out during the condensation of the alcoholic vapours. (Thenard, *Traité de Chimie.* IV. 337. Ed. 1827.) In order to form a correct idea of this apparatus, it is necessary to understand that the still and first two vessels communicate with one another by tubes, placed near the bottom of each and secured by stop-cocks, an arrangement which, in connexion with the proper relative position of the vessels, per-

mits the transfer of the liquids, in a direction towards the still, with the greatest facility.

Spirit, by repeated distillations, can be made to attain the specific gravity only of 0.825, at which density it still contains about seven and a half per cent. of water. If it be desired to obtain it perfectly free from water of dilution, the chemist is under the necessity of resorting to other methods besides simple distillation. These methods consist in subjecting the strongest spirit obtained by distillation, to the action of certain substances which have a strong attraction for water, without having much or any affinity for the alcohol. The principal substances employed for this purpose are dry carbonate of potassa (dry salt of tartar), and chloride of calcium (fused muriate of lime). These substances, when mixed with the strongest rectified spirit, combine with the water, sink from their greater specific gravity, and allow a stratum of pure alcohol to float above them, which may be separated either by decantation or a cautious distillation. By pursuing these methods until no more water can be separated, the spirit is made to attain its highest strength and lowest specific gravity. It is now the *alcohol* of the chemist, in a perfectly pure state; but as the term, alcohol, is indiscriminately applied to all spirits stronger than proof spirit, the pure liquid is generally distinguished by the name of *absolute* or *anhydrous alcohol.*

Having, in the foregoing explanations, given an account of the source of alcohol, the circumstances under which it is produced, and the various steps by which it is brought to a state of perfect purity, we are now prepared to enter upon the consideration of its properties as a chemical agent, and of its relations to pharmacy, therapeutics, pathology, toxicology, and the useful arts. Accordingly, we shall arrange what further remarks we may have to make, under these heads.

Chemical Properties of Alcohol. Alcohol is a colourless, limpid liquid, of a penetrating, agreeable odour, and strong burning taste. When anhydrous, its specific gravity is as low as 0.796 at the temperature of 60°, (0.7947 at the temperature of 59°. Gay-Lussac.) When diluted, its density becomes progressively greater in proportion to the quantity of water added. Its boiling point is lower in proportion to its purity; this point being at 176° when it has the specific gravity of 0.820. The density of its vapour is 1.61. Though so easily vaporized, it has never been congealed, having been exposed to the temperature of —91° without losing its fluidity. It is an inflammable liquid, and burns with a bluish flame without residue, the products being water and carbonic acid. It combines with water in all proportions and with condensation, and exists united with this liquid in large proportion, in the several varieties of ardent spirit of commerce. These are valued in proportion to the quantity of absolute alcohol which they contain; and as this quantity is inversely proportional to their density, their specific gravity is taken in estimating their relative strength. This is done in commerce by means of instruments with arbitrary scales, called *hydrometers*, consisting of a bulb and graduated stem, which are allowed to float in the spirit to be examined, and will sink deeper into it in proportion as it is lighter. Every different hydrometer strength corresponds with a different specific gravity; and by tables, constructed for the purpose, the per centage of absolute alcohol, corresponding to any given density, is shown. The following table, constructed by Gay-Lussac, gives the specific gravity of different mixtures of alcohol and water at the temperature of 59°, and will be found convenient for occasional reference.

Alcohol per cent. in the mixture.	Sp. gravity of the mixture.
100	0.7947
95	0.8168
90	0.8346
85	0.8502
80	0.8645
75	0.8779
70	0.8907
65	0.9027
60	0.9141
55	0.9248
50	0.9348
45	0.9440
40	0.9523
35	0.9595
30	0.9656

Alcohol acts as a solvent for a number of substances. It dissolves sulphur and phosphorus sparingly, iodine in considerable quantities, and the fixed alkalies abundantly, in the caustic but not in the carbonated state. It is capable of absorbing a large quantity of gaseous ammonia, with the effect of forming a highly stimulating liquid called *ammoniated alcohol.* As a solvent of particular vegetable principles, it is the most important agent possessed by the chemist, for prosecuting vegetable analysis. Among these substances, it is found to dissolve the organic vegetable alkalies, (*quinia*, *morphia*, &c.,) sugar, camphor, resins, balsams, soap, and the

volatile oils. The fixed oils are but sparingly soluble in it, except castor oil, which is abundantly soluble. All the deliquescent salts, except carbonate of potassa, are more or less soluble in alcohol; while the efflorescent salts, or those insoluble or sparingly soluble in water, are for the most part insoluble in this menstruum. With some substances, it combines in the solid form and in definite proportions, forming compounds, which, from their analogy to hydrates, are called *alcoates*. When allowed to react with certain acids, a class of peculiar volatile liquids called ethers are generated. (See *Ether*.) With chlorine it forms an ethereal liquid, of an oleaginous appearance, consisting of chlorine, hydrogen, and carbon. (See *Chlorine ether*.)

When the vapour of alcohol is passed through a red-hot porcelain tube, it is resolved into carburetted hydrogen, and carbonic acid and oxide, a result which proves it to consist of hydrogen, carbon, and oxygen. The exact proportions in which these elements are united are found, adopting the analysis of M. TH. DE SAUSSURE, to correspond with three equivalents of hydrogen 3, two of carbon 12, and one of oxygen 8 = 23; or, in volumes, with three volumes of hydrogen, two volumes of the vapour of carbon, and half a volume of oxygen. These constituents are generally supposed to be united in such a binary manner, as to generate two equivalents of olefiant gas 14, and one of water 9; or one volume of olefiant gas to one volume of the vapour of water; which volumes, judging from the actual density of alcohol vapour, are supposed to be condensed into one volume.

It has been stated in a preceding part of this article, that sugar appeared to be the essential material which underwent the changes implied in the term *vinous fermentation;* and that in all probability it was converted into alcohol and carbonic acid, their composition, compared with that of sugar, justifying the supposition. We are now prepared to show that the ultimate composition of sugar is precisely such as to admit of being resolved into alcohol and carbonic acid. Thus sugar, according to Dr. PROUT, consists of one equivalent of hydrogen, one of carbon, and one of oxygen. If it be supposed, in order to make the number of equivalents of hydrogen in the sugar equal to their number in the alcohol, that three equivalents of the former are decomposed, then we shall have three equivalents of hydrogen, three of carbon, and three of oxygen, as the materials of the decomposition. Now, if from these, we take one equivalent of carbon and two of oxygen, that is, the precise ingredients of carbonic acid, we shall have left three equivalents of hydrogen, two of carbon, and one of oxygen, or the exact constituents of alcohol.

Pharmaceutical Uses. Alcohol is employed of different strengths and for various purposes in pharmacy. As directed in the United States and British Pharmacopœias, it is officinal of two principal strengths, called, usually, *rectified spirit*, and *proof spirit.* Rectified spirit is denominated *alcohol* in the United States Pharmacopœia, *Spiritus Rectificatus* by the London and Dublin Colleges, and *Alcohol Fortius* by the Edinburgh; while proof spirit is named *Alcohol Dilutum* in our national standard, *Spiritus Tenuior* by the London and Dublin Colleges, and *Alcohol Dilutius* by the Edinburgh. Besides these strengths, there is a higher one, adopted only by the London and Dublin Colleges under the name of "*Alcohol;*" this name being thus used in another sense from that attached to it in the United States Pharmacopœia. The officinal "alcohol" of the London and Dublin Colleges varies in specific gravity from 0.810 to 0.815; while, according to the four Pharmacopœias first mentioned, rectified spirit varies in density from 0.835 to 0.840, and proof spirit, from 0.919 to 0.935.

Alcohol, of its different pharmaceutical strengths, is used as a solvent, a chemical agent, and a preservative from decomposition. It is employed to dissolve a large number of medicinal substances, forming solutions called *tinctures.* For making these, either rectified or proof spirit is directed, according to the nature of the substance to be dissolved. For dissolving resins, guaiac, camphor, and the volatile oils, rectified spirit, which contains about 90 per cent. of anhydrous alcohol, is employed; while for the solution of those substances, the medicinal principles of which are soluble, partly in alcohol and partly in water, it is necessary to employ proof spirit, the composition of which corresponds to equal parts of anhydrous alcohol and water. When volatile substances are made to dissolve in alcohol by the aid of distillation, the solutions obtained are called, in pharmaceutical language, *spirits;* though this term has sometimes been erroneously applied to simple alcoholic solutions, obtained by maceration or digestion. The spirits are chiefly obtained from aromatic vegetables, the essential oils of which rise with the vapour of alcohol during the distillation, and condense in the

receiver. When the solvent power of the alcohol is assisted by ammonia, as when ammoniated alcohol is employed, the solution is called a *volatile* or *ammoniated tincture;* and when assisted by ether, an *ethereal tincture.* Alcohol, when it generates ethers with acids, acts as a chemical agent in a peculiar way, which will be explained under the article *Ether.* Alcohol is often employed to obtain the medicinal principles of a substance in a separate state, when these happen to be soluble in it. For this purpose, the substance is exhausted by the alcohol, and the solution obtained distilled to dryness. Principles thus separated are called *alcoholic extracts*; and this manner of proceeding is particularly applicable to bulky medicinal substances, of which the active principles are soluble only in alcohol. In obtaining the various vegetable organic alkalies, alcohol is an almost indispensable agent. It is accordingly employed in the United States Pharmacopœia in the process for morphia, and in the United States and Dublin Pharmacopœias for obtaining the sulphate of quinia. In addition to these uses, it is added to several of the "vinegars" and "medicated waters" to preserve them from decomposition.

Alcohol, considered as a mere vehicle for medicinal substances, is not an eligible pharmaceutical agent. Its stimulating effects are often incompatible with those of the medicine of which it forms the menstruum; and, when otherwise, spirituous medicines should be prescribed with a sparing hand, for fear of begetting habits of intemperance. Every unprejudiced physician must acknowledge, upon taking a survey of the different Pharmacopœias, that the pharmacy of the present day is still overloaded with alcoholic preparations.

Therapeutical Applications. The physiological effect of alcohol is that of a potent, diffusible stimulant, acting principally upon the brain and nervous system. It was supposed by Mr. Brodie to operate on the former through the medium of the nerves; but it is now generally admitted that it is absorbed, and enters the current of the circulation. The obvious phenomena to which its ingestion gives rise, are unfortunately but too well known to require minute description here. When taken in small quantity, it first excites the nervous system; the ideas become multiplied and vivid, and sadness gives place to gaiety. The circulation becomes accelerated, the animal heat augmented, and a disposition to muscular action is manifested. By a larger dose, the symptoms are violent excitement, flushed face, giddiness, confusion of thought, and various mental affections, according to the temperament of the individual. This state of excitement usually terminates in drowsiness and profound sleep, and is generally followed, after awaking, by giddiness, headach, nausea, and vomiting. The powerful modifying influences which this agent is thus capable of exercising, render it an efficient remedy in certain states of disease. It is never prescribed in its pure state, but only in the form of ardent spirit, or as it exists in vinous liquors, such as wine, cider, malt liquors, &c., in which latter, its effects are considerably modified. In the form of ardent spirit, it is sometimes useful in diseases characterized by excessive debility. In the sinking stages of typhus, it is the main remedy to be employed; but it is unquestionably frequently resorted to in fevers, on the plea of debility, when its stimulus really aggravates the symptoms, and increases the danger of the patient. Dr. Southwood Smith, in his Treatise on Fever, admits the difficulty of deciding, in some cases of fever, on the propriety of administering alcoholic stimulus; but alleges that, when employed in doubtful cases, its effects very soon decide the question of its usefulness. If it quiets restlessness and promotes easy sleep, it may be safely continued; but if, on the contrary, it flushes the face, augments the temperature of the skin, and increases the delirium, it is hurtful, and must be laid aside. In the generality of cases in which it is proper to resort to this kind of stimulus, the best form of it is French brandy. In chronic diseases, ardent spirit should never be prescribed alone, and seldom as the vehicle of other medicines. In such cases, the long continuance of the stimulus might be the means of forming insensibly the degrading habit of intemperance.

Alcoholic preparations are contra-indicated in all inflammations, whether acute or chronic, in nearly all fevers, and, generally, in all affections in which either an organ or tissue is in a state of phlogosis.

Pathological Effects. The habitual use of alcoholic drinks, besides the moral degradation which they produce, gives rise to various diseases and organic lesions, the more important to be studied, on account of their frequent occurrence, in consequence of the large quantity consumed of these drinks. Besides occasionally inducing dyspepsia, dropsy, epilepsy, apoplexy, paralysis, and ordinary mania, it produces a peculiar maniacal affection, accompanied

by tremours of the limbs, called *Delirium Tremens.* (See this *article.*) In a few rare cases, from the excessive and long-continued use of this stimulus, it has produced a decomposition of the body, more or less extensive, as if destroyed by fire. (See *Combustion, Spontaneous.*) Among the organic lesions often produced by the habitual use of alcoholic drinks, are a particular variety of tuberculated liver, indurated pancreas, indurated mesenteric glands, scirrhous pylorus, inflammation, suppuration, and induration of the kidneys, aneurism of the heart and great vessels, &c. &c.

Toxicological Effects. Alcohol, in the shape of ardent spirits, when swallowed in large quantities at once, produces those violent and dangerous effects which characterize the action of a potent poison. In the best treatises on Toxicology, it is classed as a *narcotico-acrid poison.* When taken in the large quantities here referred to, there is seldom any preliminary excitement, but coma soon comes on, which is profound as in apoplexy. The face is sometimes livid, but more usually ghastly pale, the breathing is stertorous, the mouth frothy, and the pupils are sometimes contracted, but more frequently dilated and insensible. Death sometimes takes place immediately after the ingestion of the spirits; at other times, in a few hours. Orfila has recorded the case of a soldier who drank eight pints of brandy for a wager, and died instantly; and Christison mentions a similar case, in which death took place in four hours. Cases of the same kind are not of unfrequent occurrence, though not generally recorded in medical journals or publications. After death, the rugæ of the stomach frequently exhibit a cherry-red colour; but sometimes this viscus is quite natural in appearance. The brain is usually greatly congested; and sometimes, probably in persons predisposed to apoplexy, extravasation of blood occurs. In cases, however, of rapid death from an overwhelming dose of the poison, extravasation is not apt to take place.

In cases of danger to life from extreme intoxication, an emetic may sometimes be administered with good effect. If this cannot be swallowed, the stomach-pump should be resorted to. Cold affusion often proves a valuable resource. According to some authorities, acetate of ammonia is a useful remedy, being alleged to act as a counter-poison.

Uses in the Arts. Alcohol, more or less concentrated, is used extensively by perfumers and distillers in making essences and cordials. It is also employed in preparing drying varnishes. It acts as a powerful antiseptic, and hence is frequently used for preserving anatomical preparations. The way it effects this purpose, is by depriving them of water, without which the putrid decomposition cannot take place. The spirit for this purpose should contain from 60 to 75 per cent. of anhydrous alcohol.

Franklin Bache.

ALCORNOQUE. A bark from South America, which at one time enjoyed much reputation as a specific in phthisis pulmonalis, though it is now scarcely if ever employed in that or any other disease. There is no certainty as to the tree furnishing this bark; but from the researches of M. Poudeux it appears probable that it belongs to the natural order of Guttifereæ. In South America it is known under the name of *Chapano Alcornoque,* the latter term meaning cork, and applied by the Spaniards to every tree having a spongy bark, whence it was at one time believed that the article under consideration was merely the bark of young branches of the *Quercus suber.*

The alcornoque is in thin convoluted pieces, composed of two layers, the outer of which is reddish, granular, and spongy, having a very astringent and slightly bitter taste; the interior is yellowish and fibrous. It was given in doses of half a drachm in substance, or in a strong decoction, of which the dose was from 2 to 3 teaspoonsfull every two hours: this causes vomiting, and in larger doses, copious stools, followed by abundant sweats. It has been analyzed by several chemists; the best account of its composition, however, is that given by M. Rein, who states he found it composed of, Gum 105, extractive matter 102, resin 54, woody fibre 303, water 136, and traces of tartaric acid.

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R. E. Griffith.

ALETRIS. (*Botany.*)

Sex. Syst. Hexandria Monogynia. *Nat. Ord.* Asphodeleæ.

Gen. Ch. *Corolla* tubular, six-cleft, wrinkled, persistent. *Stamens* inserted into the base of the segments. *Style* triangular, separable into three. *Capsule* opening at the top, three-celled, many-seeded. BIGELOW.

Aletris farinosa.—*Aletris alba*, MICHAUX, PURSH.—*Star-grass, Blazing star, Mealy starwort.*—This is an indigenous perennial plant, found in almost all parts of the United States. The leaves, which spring immediately from the root, are sessile, lanceolate, entire, pointed, nerved, very smooth, and of unequal size, the largest being about four inches in length. They spread out on the ground in the form of a star, and thus give to the plant that peculiar aspect from which its vulgar names have originated. From the middle of this circle of leaves, a flower-stem rises one or two feet in height, nearly naked, with remote scales, which sometimes become leaves. It terminates in a slender scattered spike, the flowers of which stand on very short pedicels, and are furnished with minute bractes. The calyx is wanting. The corolla is tubular, oblong, and divided at the summit into six spreading segments. It is white, and presents, especially when old, a mealy rugose appearance on the outside, which has given origin to the botanical title of the plant. The star grass prefers a dry, somewhat sandy soil, and flourishes in sterile fields, on the sides of hills, and in gravelly woods. It flowers in June and July.

The officinal part is the root, which is designated in the United States Pharmacopœia by the name of ALETRIS. It is small, crooked, branched, blackish externally, brown within, and of an intensely bitter taste. Its bitterness is extracted by both water and alcohol, but, according to Dr. BIGELOW, most perfectly by the latter. No detailed analysis has been published, though there is reason to believe that it contains resin and extractive matter.

In small quantities, the root acts simply as a tonic, increasing the appetite, and invigorating digestion. More largely taken, it sometimes produces nausea and a disposition to vomit. SHÖPF states that it is gently cathartic; and in large doses it may possibly produce this effect, though in an instance related to Dr. BIGELOW, in which 20 grains of the powder were taken, the bowels remained undisturbed. In the case alluded to, much nausea and some subsequent dizziness were experienced. The dizziness was probably a mere consequence of the stomachic affection, and its occurrence scarcely justifies the inference which appears to have been drawn from it, that the root possesses narcotic properties.

This tonic has been used for the same purposes as the ordinary bitters, to promote appetite, facilitate digestion, and invigorate the system generally. SHÖPF says that it is febrifuge; and it may have done good in intermittent and certain forms of remittent fever, upon the same principles with the more active tonics. We are told by PURSH that it is considered an excellent remedy in colic, and hence has been called *colic-root*. If useful in this complaint, it is probably in those forms of it which depend on flatulence and enfeebled digestion. According to Dr. CUTLER, it has been esteemed useful in chronic rheumatism; and Dr. THATCHER states, in his Dispensatory, that it enjoys, in the Southern States, considerable reputation as a remedy in dropsical affections. It has been more used in domestic practice, than by physicians. The dose of the root in powder, as a tonic and stomachic, is about ten grains. It may also be given in infusion or decoction.

There is another indigenous species of *Aletris*, so closely resembling the *A. farinosa* as to be considered by some only as a variety, but distinguishable by its narrower and longer leaves, and by its yellow flowers, which are, moreover, somewhat later in their appearance. It is the *Aletris aurea* of MICHAUX. In sensible properties it resembles the former species, and probably possesses the same medical virtues.

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GEO. B. WOOD.

ALEXIPHARMIC. (*Mat. Med.*) Alexipharmica. (From αλεξειν, to repel, and φαρμακον, poison.) Remedies which were supposed to possess the power of preserving an individual from the action of poisons, or to expel and counteract their effects. In the earlier ages of medical science, the utmost confidence was entertained in the virtues of certain articles as preservatives against poisons, and it is a curious fact that of the numerous articles which were implicitly relied upon for this purpose, there is scarcely one that would be efficacious in case of real poisoning.

Almost all the alexipharmics, theriacs and alexiterics of the ancients, of which we have any knowledge, consisted in powerful tonics, stimulants and diaphoretics, either given alone or in the most compound form, as the celebrated Mithridaticum, and no less esteemed Orvietan, which consisted of a union of almost every stimulant known. Modern science has very properly abolished these classes of remedies as worse than useless. The best antidote for poisons taken into the stomach, is their expulsion by means of an emetic or by mechanical means; at the same time it cannot be denied that whilst we have no alexipharmic applicable to all poisons indiscriminately, there can be no doubt of our possessing antidotes against particular articles. (See *Antidotes.*) As regards the use of this class of remedies in those cases in which it was supposed that certain morbid poisons were developed in the system, it must have been attended with the worst results. This pretended development of poison in the system, being, in a majority of cases, the occurrence of the highest degree of inflammation of some of the important organs, the exhibition of stimulants with a view of expelling or overcoming the morbific matter, must have only added to the evil, though, unfortunately for the interests of science, this idea, in a modified form, is still pertinaciously clung to by many practitioners,—witness the profusion of stimulants of all kinds exhibited in what are termed putrid fevers, &c.

R. E. Griffith.

ALEZE, ALESE, or ALAISE. (From αλεξω, I protect.) A piece of linen or muslin several times folded, employed for the protection of the bed and clothes of patients, from excrementitious matters, blood, pus, &c. Alezes are extremely useful for the preservation of cleanliness, so important to be maintained around the sick and wounded. The best material for their construction is a linen or muslin sheet, free from patches or elevated seams, and partly worn, as it is then softer and more readily absorbs the discharges. Care must always be taken that it is smoothly folded. When the discharges are so profuse as speedily to soak through the aleze, a piece of waxed or gum-elastic cloth, or oiled silk, ought to be spread beneath it, the more effectually to guard the bed. An aleze should be placed under patients who discharge their urine or feces involuntarily; beneath women after delivery, to receive the lochia, &c. In all bloody operations; during the dressings of wounds, ulcers, &c.; when fomentations are applied, or enemata administered, &c., the bed ought to be protected by an aleze; and in operations when the patient is seated, one should be placed around him to protect his dress. When the aleze becomes foul, it is necessary to replace it with a clean one, which is most readily accomplished by introducing one side of the latter between the folds of the former and attaching them together by pins. The heads of the pins should be placed in the direction to which the aleze is to be drawn, to prevent their points pricking the patient. By drawing the soiled aleze in the direction opposite to the fresh one, the latter will be readily introduced under the patient. The hand should then be placed over the aleze and all folds and ridges obliterated, as they might occasion inconvenience or produce painful excoriations.

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I. H.

ALGID. (From *algor*, cold.) *Algidus*, Lat.; *Algide*, Fr. Cold. This epithet has been bestowed on certain diseases or the stage of diseases, which exhibit as a predominant symptom, coldness of the skin and limbs. Thus the cold plague of our southern States is named algid intermittent; the stage of collapse in malignant cholera, the algid stage, &c. Algidity is the precursory state to fever, and it generally accompanies all violent pains situated in important organs, as in the heart, stomach, kidneys, &c. In short, this symptom is present in all cases where there is a violent irritation of an internal organ, causing a centripetal movement of the blood, and exhausting the external surface of its sanguine fluid, prostrating its energies and arresting the organic actions upon which the generation of animal temperature depends. This subject will with more advantage be discussed when the pathological states of animal temperature come to be considered. I. H.

ALIBLE. (From *alere*, to nourish.) *Alibilis*, Lat. Substances capable of being animalized are thus denominated. It is applied to that portion of the chyme destined to nutrition, separated from the excrementitious matters; it is synonymous with nutritive. I. H.

ALICES. (From αλιζω, I sprinkle.) Reddish spots in the skin which precede the development of variolous pustules. I. H.

ALIENATION. (From *alienare*, to alienate or estrange.) Estrangement of mind. (See *Insanity*.) I. H.

ALIMENT. (From *alere*, to nourish.) Substances which furnish materials necessary for the growth and renewal of the organs. (See *Food*.) I. H.

ALIMENTARY. Relating to food, or having the power to nourish. I. H.

ALIMENTARY CANAL. The long passage, commencing at the mouth and terminating at the anus. I. H.

ALIMENTATION. The act of nourishing, nutrition. (See this last word.) I. H.

ALISMA. (*Botany* and *Mat. Med.*)

Sex. Syst. Hexandria Polygynia. *Nat. Ord.* Alismaceæ.

Gen. Ch. *Perianth* six parted; three outer segments persistent, calycine; three inner coloured, petaloid. *Stamens* six. *Ovaries* and *styles* numerous. *Capsules* numerous, distinct, one-seeded, not opening. Beck.

A. plantago. Water Plantain. *Plantain d'eau*, Fr.; *Wasserwegerich*, Germ. —*Sp. Ch.* Leaves ovate-cordate, acute or obtuse, nine nerved; flowers in a compound verticillate panicle; fruit obtusely triangular. Beck. This plant is found abundantly both in Europe and the United States, on the borders of ditches and other wet situations. The root is perennial and fibrous, striking deeply into the mud under water. The leaves are all radical, erect, on long footstalks, ovate, acute, entire, ribbed, smooth, various in size and breadth. The flower stalk is about two to three feet in height, and is divided at its upper part into numerous verticillate, compound, bracteated branches. Each flower is furnished with a partial peduncle, and is of a white or pale rose colour. The water plantain appears to have attracted the attention of physicians at a very early period, as Dioscorides speaks of it as an efficacious antidote for opium; its principal celebrity, however, has arisen from the eulogies bestowed on it in Russia as a complete specific in hydrophobia. As the utmost confidence is expressed by many distinguished writers as to its powers in this disease, it has been allowed a place in this work, although we fear that further experiments will show that it is entitled to no higher rank than the Scullcap or Pimpernel. The part used is the root, which is given in doses of half a drachm to a drachm, either in powder on bread and butter, or infused in wine. Dr. Martius says that in the neighbourhood of Toula, where it is always used in the form of powder, he has seen it successfully employed in more than a hundred cases. (*Bull. de Sc. Méd.* 1828. p. 354.) Fee also quotes several cases from German writers where it was equally successful. Like all other specifics in this terrible disease, it has been found wholly inefficacious when subjected to rigid experiments. Merat and De Lens state that a committee appointed by the Royal Academy of Medicine of Paris, on the subject of Hydrophobia, gave it fair trial, and were convinced of its total want of curative powers.

The real medicinal qualities of the Alisma are those of an irritant, like the Ranunculaceæ, to which it is closely allied in many particulars. Thus, the fresh root, which is acrid and nauseous, and also the leaves bruised and applied to the skin, will excite an active irritation, and even vesication. When dried, however, it affords a farina, which, like that of the arum, is mild and nutritive. De Haen has proposed the substitution of the leaves of the plant under consideration, for those of the uva ursi, in diseases of the urinary organs.

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R. E. Griffith.

ALKALESCENCE. The state of being slightly alkaline; or a tendency to become alkaline. It expresses the same idea relatively to the alkaline quality, as ascescence does to acidity. Substances which contain nitrogen, whether of animal or vegetable origin, are liable to become alkalescent upon spontaneous decomposition, in consequence of the formation of a portion of ammonia. According to a theory formerly in vogue, the fluids of the body are liable to become alkalescent, and in this state are productive of a numerous class of diseases. This pathological state, however, is not now generally admitted; though the contrary one of acidity is recognized as occurring occasionally in morbid excess in the sweat and urine, and in the secretions of the stomach. The use of alkalies, in the latter morbid condition, especially when it relates to the urine, has become a settled practice of undoubted value. (See *Alkalies*, *Alkalinity*, and *Antilithics*.)

Franklin Bache.

ALKALIES. (From the *Arabic* article

al, and *kilyon*, the ashes of maritime plants.)

The term *salifiable base* is used by the chemist to denote all those compounds which have the power of destroying the distinctive properties of sour substances (acids) by combining with them, the combination being attended with a loss of their own. The essential character of such compounds is that they are *electro-positive* when compared with the acids which are *electro-negative;* and it is this contrast in the electrical condition of these two great classes of chemical compounds that causes their strong mutual affinity. Now *alkalies* constitute a subdivision of salifiable bases, and the term, taken in its most comprehensive sense, embraces such of these bases as have an acrid or bitter taste, and possess the property of changing vegetable blue colours to green.

Classification and Distinctive Characters of Alkalies. Alkalies may be primarily divided, according as they are found in the mineral kingdom, or are exclusively the product of vital action. Those which are found in the mineral kingdom may be conveniently called *inorganic alkalies*, and comprise *potassa*, *soda*, *lithia*, and *ammonia;* while those which are exclusively the product of vitality are entitled to the designation of *organic alkalies.* But as organic alkalies have as yet been detected only in vegetables, they are usually designated by the name of *vegetable organic alkalies*, or simply *vegetable alkalies.*

The *inorganic alkalies*, according to their relation to caloric, are divided into *fixed* and *volatile.* Potassa, soda, and lithia, being fixed in the fire, are called *fixed alkalies;* while ammonia, on account of its gaseous nature, is denominated the *volatile alkali.*

The *fixed alkalies* have a peculiar acrid taste, resembling that of the ashes of plants. They are soluble in water, and are capable of destroying animal matter, even in the living state. They possess the latter property, only when pure or combined with water, in which state they are said to be *caustic;* but when united with carbonic acid, they lose their causticity, retaining their ashy taste, and are now said to be *mild.* Another character is their property of converting to green various blue and red colours, as, for example, the colouring matter of the violet, of purple cabbage, and of the red rose; of changing various red colours to blue, as of litmus reddened by an acid; and finally of turning to brown certain yellow colours, as those of turmeric, rhubarb, and Brazil wood. The power of thus affecting colours is possessed, however, though in a slight degree, by the peroxide of lead.

Potassa exists in nature, as a constituent of various minerals, but principally as an ingredient of plants not of marine origin. It is found in the most disseminated minerals, such as feldspar and mica; of the former of which it constitutes a sixteenth part, of the latter, usually about a twelfth. It is from the ashes of plants, however, that this alkali is most readily obtained, the part called wood being usually selected for the purpose. *Soda* is procured either from the ashes of marine or maritime plants, or, by chemical decomposition, from certain salts which contain it as their base. Formerly, it was sometimes obtained from a mineral called *natron*, which is a native carbonated soda. Potassa, being usually procured from the vegetable kingdom, was formerly called *the vegetable alkali*, and soda, from its occasional mineral origin, *the mineral alkali;* but the progress of knowledge having shown that potassa exists in the mineral kingdom, even to a greater extent than soda, while soda itself is found in vegetables, and that the term *vegetable alkali* belongs properly to a newly discovered class of vegetable principles; these designations, as applied to the fixed alkalies, are abandoned by the best chemists of the present day. *Lithia* is derived exclusively from the mineral kingdom, and is the only one of the fixed alkalies entitled to be called a *mineral alkali*, provided it were expedient to retain this name. (See *Potassa*, *Soda*, and *Lithia.*) Besides these three alkalies, some chemists have arranged *baryta*, *strontia*, *lime*, and *magnesia*, under the fixed alkalies; but these substances are more correctly called *alkaline earths.*

The *volatile alkali* or *ammonia* acts on vegetable colours precisely in the same way as the fixed alkalies. While the latter have no odour, unless when in a state of boiling concentrated solution, ammonia possesses a pungent smell, so peculiar as to distinguish it from all other substances.

The *vegetable alkalies* are charactorized by their extremely bitter taste, their generally poisonous nature, and, with the exception of two, (*curarin* and *nicotin*,) by their sparing solubility in water. Many of them possess the property of restoring vegetable blue colours previously reddened by an acid, and of changing to green the syrup of violets. The majority of them may be obtained in crys-

tals. They saturate acids perfectly; but, in consequence of the largeness of their equivalent numbers, arising from the great number of atoms entering into their composition, they require but a small proportion of acid for that purpose. The salts which they form are either neutral, or bisalts, and are distinguished, like the alkalies themselves, by their bitter taste. Most of the salts are crystallizable; some, however, form a gummy mass, while others are obtained in flocks, insoluble in water, but soluble in an excess of the acid.

The vegetable alkalies at present recognized as possessing the alkaline quality with certainty, are *morphia*, *narcotin* or *narcotia*, *strychnia*, *brucia*, *quinia*, *cinchonia*, *veratria*, *emetia*, *delphia*, *solania*, *corydalia*, *curarin* or *curaria*, and *nicotin* or *nicotia*. Those of doubtful character are *picrotoxin*, *violin*, *daphnin*, *pariljin*, *smilacin*, *cynapin*, *sanguinarin*, *guaranin*, *esenbeckin*, *crotonin*, *buxin*, *atropin*, *eupatorin*, *meconin*, *hyoscyamin*, *coniin*, *digitalin*, *hyssopin*, *fumarin*, and *crystallin*. (See these words.) The credit of having first made known the existence of vegetable alkaline principles is due to Sertuerner, who discovered the first substance of this nature (morphia) in 1816. Soon after, Pelletier and Caventou detected other vegetable alkalies in different species of strychnos, in the veratrum album, and still later in Peruvian bark. Other chemists soon after discovered additional principles of the same kind; and though, at the present day, the number known is considerable, there is reason to believe that these constitute but a small part of the entire number existing in nature. The vegetable alkalies are found naturally in the state of salts, being combined usually with malic acid, sometimes with gallic acid, and, in a few cases, with an acid peculiar to the plant itself.

The best mode of obtaining the vegetable alkalies, is to extract them from an aqueous infusion of the vegetable matter which contains them. The infusion formed is to be evaporated to lessen its volume; and the vegetable alkali is then precipitated, either by an inorganic alkali, or by boiling it with some earth, and preferably with magnesia. The alkali or earth employed as the precipitant, combines with the acid with which the vegetable alkali is naturally united; and this latter being thus set free, precipitates in the great majority of cases, in consequence of its sparing solubility. Curarin and nicotin, however, dissolving with some facility in water, cannot be obtained in this way. The precipitated alkali generally carries down with it some colouring matter, which may be removed either by a very weak solution of potassa, or by weak alcohol, used cold or warm. It is then dissolved in boiling anhydrous alcohol, from which it is obtained by allowing the solution to cool, or by distilling off the alcohol. Sometimes the colouring matter adheres with so much obstinacy, that it can be separated, only by combining the vegetable alkali with an acid, boiling the solution of the salt formed with animal charcoal, filtering the liquor, and then adding an inorganic alkali, which will precipitate the vegetable alkali in a state of purity.

Chemical Constitution of Alkalies. The chemical constitution of these substances presents remarkable differences, considering that the same general properties are possessed by them all, such as saturating acids, affecting vegetable colours in a peculiar way, &c. These facts seem to show that their distinctive property of alkalinity is adventitious, and entirely independent of their composition. The fixed alkalies are metallic oxides, the volatile alkali, (ammonia,) a compound of hydrogen and nitrogen. The vegetable alkalies uniformly consist of hydrogen, carbon, oxygen, and nitrogen, the latter element being their characteristic ingredient. The quantity of carbon varies from two-thirds to three-fourths of their weight. The hydrogen varies in round numbers from six to eight per cent.; the oxygen from six to twenty-three per cent., and the nitrogen from four to nine per cent. No well characterized animal alkali has yet been discovered. Judging from their relative composition, it would seem more natural to arrange ammonia with the organic alkalies, than with the inorganic. Though occasionally found in the mineral kingdom, it belongs properly to organic matter, being derived almost exclusively from animal substances. In some of these it exists ready formed, while from all kinds of *azotized* animal matter, it may be obtained by destructive distillation. It agrees, besides, with the organic alkalies, in being independent of metallic matter, while it contains two out of the four constituents of these alkalies. It differs, however, in being capable of production by art, which is not the case with any of the organic alkalies. Upon the whole, it might not be considered inappropriate to denominate ammonia an *animal organic alkali*.

Therapeutical Applications of Alkalies. These applications, as well as those to pharmacy, will be best studied under

the head of each alkali; the generalities which admit of being mentioned here, being few and unimportant. The fixed alkalies are employed in their hydrated state as caustics, and carbonated as antacids and antilithics. Ammonia is used as a stimulant and rubefacient. The vegetable alkalies are, with few exceptions, extremely active as medicinal agents, and some of them rank as potent poisons. Their therapeutical applications are very diversified, and will be described under the head of each. The saline combinations of the entire class of alkalies constitute in many instances important medicines, which will be noticed in their proper places. The toxicological properties of the fixed alkalies will be mentioned under potassa, of ammonia, under the head of that alkali, and of such of the vegetable alkalies as are poisonous, under the head of each.

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Franklin Bache.

ALKALINITY. The quality of being alkaline. Those properties, the coexistence of which in a body constitutes the alkaline quality, have been fully explained under the head of *Alkalies*, to which article the reader is referred. The term is to be taken as having a meaning precisely the reverse of that of acidity. Alkalinity, as a quality, is not possessed by the alkalies only; but the term is extended in its application to express the condition of all compounds and mixtures, in which alkalies exist with predominance of their properties. Thus all alkaline salts which contain an acid of feeble neutralizing power, exhibit the quality of alkalinity. Examples are furnished by the carbonate of potassa (salt of tartar), the carbonates of soda and ammonia, and the borate of soda (borax).

In physiology and pathology, the term alkalinity is employed to express the predominance of the alkaline property in certain animal fluids, whether in health or disease. Thus, in a state of health, alkalinity is exhibited by the serum of the blood, by the saliva, bile, chyle, mucus of the nose, synovia, semen, and the liquor of the amnios. On the other hand, the gastric and pancreatic juices, the sweat, urine, and milk, possess naturally an acid reaction. These healthy chemical conditions of the fluids may be morbidly increased in intensity, or otherwise entirely reversed. Thus the acid in the gastric juice may be morbidly increased in quantity, or altered in quality; while the natural acidity of the urine may be replaced by an alkaline condition, productive of the deposition of the earthy phosphates. (See *Alkalescence*, and *Fluids, Pathology of.*)

F. B.

ALKALOID. A name formerly applied to distinguish the *organic vegetable alkalies*, such as *morphia*, *quinia*, &c. It means,—*like an alkali*, and was formerly applied to these vegetable principles, under the erroneous impression that, though alkaline, they were not perfect alkalies. At present their perfect alkalinity is recognized; and they are, accordingly, classed by the best writers as a subdivision of the *alkalies*, under which word they are described.

F. B.

ALKANET. *Orcanette*, Fr.; *Alkanne*, Germ.

The term alkanet was probably derived from the *henna* or *al-henna* of the Arabians, which is the name given to the *Lawsonia inermis*, a shrub growing in Egypt, Syria, Arabia, and the East Indies, and employed in those countries for staining the hair, nails, and skin. The colouring principle is contained both in the leaves and root; and in the German works, the latter is described as the *true alkanet*, while the drug usually sold under the name of alkanet is distinguished by the epithet *false*. But the root of the *L. inermis* never reaches the drug market of this country; and the only kind of alkanet known is that derived from the *Anchusa tinctoria*, which grows in the island of Cyprus, in the Morea, and in other parts of South-Eastern Europe. (See *Anchusa.*) This plant has been confounded by many writers with the *Lithospermum tinctorium*, which inhabits the south of France, and is said by some of the French writers on drugs to be the source of alkanet. The two plants closely resemble each other, and it is not impossible that the roots of both may be employed under the same name.

Properties. Alkanet is in pieces three or four inches long, of various thickness, from the size of a quill to that of the little finger, somewhat twisted, consisting of a dark-red, easily separable bark, and an internal ligneous portion, which is reddish externally, whitish near the centre, and composed of numerous, slender, cohering fibres. As it reaches this country, it is usually much decayed internally, very light, and of a loose, almost spongy tex-

ture. The fresh root has a faint odour, and a bitterish astringent taste; but when dried it is nearly inodorous and insipid. Its colouring principle, which is most abundant in the cortical part, is soluble in alcohol, ether, and the oils, to which it imparts a fine deep red; but is insoluble in water. The alkalies in excess dissolve it, at the same time changing its colour to blue.

Uses. Alkanet is somewhat astringent, and was formerly considered useful in various complaints; but it is now employed only as a colouring substance. Oils, ointments, and plasters, may be beautifully reddened by one-fortieth of their weight of the root. The drug is said to be used in the preparation of spurious Port wine.

GEO. B. WOOD.

ALLANTOIC ACID. A peculiar acid existing in the liquor of the allantois of the cow, a fluid supposed to be the urine of the fetal calf. It is obtained by treating the alcoholic extract of the boiled liquor with cold water, which leaves undissolved the acid, which may then be taken up by boiling water. This solution, by refrigeration, lets fall the acid, crystallized in long, narrow, four-sided, transparent, pearly prisms. Allantoic acid is permanent in the air, is devoid of taste or smell, and reddens litmus slightly, being a very feeble acid. It dissolves in 400 parts of cold, and 30 parts of boiling water, and is soluble also in alcohol. With bases it forms peculiar salts called allantoates. It has been analyzed both by LASSAIGNE and LIEBIG, who agree in reporting its ultimate constituents to be hydrogen, carbon, oxygen, and nitrogen, but differ extremely as to the proportions in which they find them united.

This acid was discovered by VAUQUELIN and BUNIVA, in what they considered to be the pure liquor amnii of the cow; and hence they called it *amniotic acid.* LASSAIGNE, however, asserts, as the result of numerous experiments, that the acid in question exists in the liquor of the allantois exclusively, and not a trace of it in the liquor amnii. It was on this account that he changed the name conferred by its discoverers into that of *allantoic acid.*

FRANKLIN BACHE.

ALLANTOIS. (From αλλας, a gut, and ειδος, like.) αλλαντοειδης, Gr.; *Membrana urinaria, M. media, M. farciminalis,* Lat. *Allantoid membrane.* An oblong, white, thin, transparent, membranous sac, situated between the chorion and amnios in most vertebrated animals. It disappears, or at least becomes inactive, at the third month of pregnancy. The existence of this membrane in the human ovum is still a question among anatomists. LOBSTEIN is of opinion that the umbilical vesicle in man is the allantois of the other mammalia. MECKEL considers the two as entirely distinct, and says that they coexist in man as in the other mammalia. He asserts that he has twice found in a human fœtus, about four weeks old, between the amnios and chorion, and independent of the umbilical vesicle, a larger pouch, with thin parietes, collapsed and containing a limpid fluid. The allantois is believed by most physiologists to be the reservoir of urine, which is carried to it by the urachus from the bladder. (See *Ovum.*)

MECKEL. *Manual of General, Descriptive, and Pathological Anatomy.* Translated by A. S. Doane. III. 512. Philadelphia, 1832.

I. H.

ALLIACEOUS. (From *allium*, garlic.) Appertaining to garlic. I. H.

ALLSPICE. (See *Pimento.*)

ALLIUM. (*Botany.*)

Sex. Syst. Hexandria Monogynia.—*Nat. Ord.* Asphodeleæ.

Gen. Ch. *Corolla* six-parted, spreading. *Spathe* many-flowered. *Umbel* heaped. *Capsule* superior. *Linn. Sp. Plant. edit. Willd.*

This is an extensive genus of bulbous plants, including, according to GEIGER, not much less than one hundred species, which bear to each other a close resemblance in sensible properties and effects upon the system. They are all pervaded by a pungent, acrid, volatile oil, upon which their peculiar odour and taste, as well as their medical properties, depend, and which appears to differ, in the different species, rather by shades of flavour and strength, than in essential qualities. This oil, when the plant is eaten, diffuses itself over the whole system, communicating its odour to the breath and to the various secretions, and seeming to fix itself even in the solids. Hence arises the unpleasant flavour of the milk and flesh of animals allowed to feed in pastures where a species of Allium abounds. The oil is diffused through the whole plant, but is especially abundant in the bulb, which is, therefore, in general, the most active part. Only three species have been admitted as officinal in the United States or Great Britain. These are the *A. Cepa* or onion, recognized by the Dublin College, the *A. Porrum* or leek, by that of London, and the *A. sativum* or garlic, by all the British Colleges, as well as in the United States Pharma-

copœia. Of the species growing wild in this country, amounting to nine or ten in number, none are employed in medicine.

1. *Allium Cepa.—Onion.—Ognon*, Fr.; *Zwiebel-Lauch, gemeine Zwiebel*, Germ. —*Sp. Ch.* "Scape naked, ventricose beneath, longer than the round leaf." *Linn. Sp. Plant, edit. Willd.* The onion is usually described as a perennial plant, but, according to Lindley and some others, is biennial. The bulb is of various shapes and dimensions, but generally roundish, and somewhat flattened above and below. It is composed of concentric fleshy and juicy layers, surrounded externally by several thin, dry, membranous coats, which are reddish, yellowish, or white, according to the variety. The root consists of fibres proceeding from the bottom of the bulb. The leaves are hollow, cylindrical, and pointed. The scape is naked, hollow, somewhat swollen towards the middle, and longer than the leaves. It rises from one and a half to two feet in height, and terminates in a simple spherical umbel of white flowers. The onion is supposed to have come originally from Asia; but is now cultivated throughout the civilized world. The bulb is the part employed. Numerous varieties have been produced by cultivation; but they may all be arranged under the two divisions of the red and white onion. The white bulb is the mildest and sweetest. It is said that the onion in warm climates is less acrid than in countries where the winters are severe.

The bulb has, in a high degree, the peculiar odour of the plant, and is so pungent, that when cut or peeled, it will often draw tears from the eyes. Its taste is sweetish, acrid, and peculiar. Fourcroy and Vauquelin found it to contain a white, acrid, volatile oil, holding sulphur in solution, albumen, much uncrystallizable sugar and mucilage, phosphoric acid both free and combined with lime, acetic acid, citrate of lime, and lignin.

Onions are a general stimulant, exciting moderately both the circulatory and nervous systems, and exhibiting some tendency to increase the secretions, particularly those from the lungs and kidneys. Externally applied, they act as rubefacients. They possess the properties of garlic in an inferior degree. When taken in large quantities, they sometimes produce flatulence, thirst, febrile heat, head-ache, troubled dreams, &c.; effects which are ascribable partly to their indigestible nature, partly to the stimulant properties of their volatile oil. As an article of food, they have been employed from the remotest antiquity. In the raw state, or pickled in vinegar, they are sometimes used as a condiment to stimulate digestion, or correct the action of flatulent vegetables; but the offensive odour they impart to the breath, renders them repulsive to most persons. When thoroughly boiled, they lose their volatile oil, and become a mild, though not very digestible article of diet. As a medicine, they are not much employed. The juice, formed into a syrup with sugar, is given occasionally in chronic pulmonary affections, and in the declining stages of infantile catarrhs, in which it proves useful not only by its expectorant qualities, but also by the support which it yields to the nervous system. It has been given also in dropsy and calculous affections, and was at one time thought to exercise a solvent power over stone in the bladder, in consequence of the phosphoric acid it contains; but any good effect which it is capable of producing in these affections, must be ascribed to its action upon the kidneys. Onions roasted, and split in two, or reduced to a pulp, are frequently applied externally as a suppurative cataplasm, and are particularly useful in languid indolent tumours.

2. *Allium Porrum.—Leek.—Poireau*, Fr.; *Gemeiner Lauch*, Germ.—*Sp. Ch.* "Stem flat-leaved, umbelliferous, stamens tricuspidate, root tunicated." *Linn. Sp. Plant, edit. Willd.* This species of Allium is biennial, with a small white bulb, consisting of concentric layers; flat, thickish, juicy leaves, from half an inch to an inch broad; and a round stem, from a foot and a half to two feet high, leafy below, and terminating in a large spherical umbel of pale-red or white flowers. The leek is said to be originally from Switzerland, but is now cultivated as a garden vegetable in various parts of the world.

All parts of the plant have an offensive, somewhat pungent odour, and an acrid taste; but the leek is considerably milder than either the onion or garlic. These properties, depending on a volatile oil, are dissipated by decoction. The bulb is ranked among officinal medicines by the London College, under the title of *Porri radix.*

Its medical properties are those of the preceding species, in an inferior degree. Being highly mucilaginous, it is said to have proved useful to persons affected with chronic catarrh of the bladder. It is, however, used almost exclusively as an article of food, and as such was known to the ancients. The leaves, while young and tender, are used in broths, and sometimes enter as an ingredient into laxative injections, in cases of intestinal flatulence. The

expressed juice may be given in the dose of one or two fluidrachms, mixed with syrup.

3. *Allium Sativum.—Garlic.—Ail*, Fr.; *Knoblauch*, Germ.—*Sp. Ch.* "Stem flat-leaved, bulbiferous; bulb compound; stamens tricuspidate." *Linn. Sp. Plant, edit. Willd.* Garlic is a perennial plant, with a compound bulb, consisting of several smaller bulbs, which are loosely surrounded by several thin, dry, membranous, and usually whitish coats. The stem, which is from a foot and a half to three feet high, is round, smooth, and furnished for about one-half of its height with long, flat, nerved, grass-like-sheathing leaves. At its summit is a cluster of mingled bulbs and flowers, enclosed at first in a spathe furnished with a long beak, but ultimately bursting through the side of the spathe, which withers. The flowers are small and whitish, and project on peduncles of considerable length from between the bulbs. They appear in June and July, and are followed by a three-celled capsule containing roundish seeds. Garlic is supposed to have been originally a native of Sicily. It now grows wild in various parts of the south of Europe and Germany, and is cultivated almost everywhere in gardens. In this country it is called English garlic, to distinguish it from our native species. The bulb is the part used. (See *Garlic.*)

Besides the species of Allium above-mentioned, various others are more or less cultivated as culinary vegetables. Among these the most prominent are, 1. the *A. Ascalonicum*, or *shallot*, one of the mildest species, a native of Syria and Asia Minor, and supposed to have been brought by the crusaders from Ascalon in Palestine; 2. the *A. fistulosum*, or *Welsh onion*, which has scarcely any bulb, and is grown as a spring salad; 3. the *A. schœnoprasum*, or *chives*, and the *A. Scorodoprasum*, or *rocambole*, used for the same purposes as garlic, but of a more delicate flavour. Shöpf says of the *A. Canadense*, one of our native species, called *meadow-garlic*, that its spirituous infusion is used in calculous complaints.

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ALMONDS.—Amygdala, U. S. Ph.—*Amandes*, Fr.; *Mandeln*, Germ.

Almonds are the nuts of the *Amygdalus communis.* (See *Amygdalus.*) Two varieties are employed, differing essentially in their properties, and requiring a separate consideration. They are distinguished by the names of *sweet almonds* and *bitter almonds.*

1. Sweet Almonds.—*Amygdalæ dulces*, Officin.—*Amandes douces*, Fr.; *Süsse Mandeln*, Germ. These are the product of the variety *dulcis* of the *A. communis*, or common almond-tree. They are imported chiefly from the south of France, the Mediterranean coast of Spain, and Italy. Several varieties of the sweet almonds are known in commerce, differing in their shape or size, or in the character of their shell. The most striking distinction is into the *hard-shelled* and *soft-shelled* almonds, the latter of which are usually preferred for the table, and are considered by some as derived from a distinct species of Amygdalus. These differences, however, are of little consequence in a medical point of view. The kernels are sometimes imported deprived of the shell.

Properties and Composition.—The shape and general appearance of almonds are well known. Each kernel consists of two white cotyledons, invested by a thin, yellowish-brown, longitudinally wrinkled, powdery coat, which is of a slightly astringent taste, and is easily separable from the cotyledons after immersion in hot water. Almonds are generally deprived of this coat before being used medicinally, and are then said to be *blanched.* In this state they are inodorous, and of a sweetish very agreeable taste. According to M. Boullay, the kernels contain in 100 parts, 5 parts of pellicle, 54 of fixed oil, 24 of albumen, 6 of uncrystallizable sugar, 3 of gum, 4 of fibrous matter, 3.5 of water, and 0.5 of acetic acid, including loss. When rubbed with water, they form a milky emulsion, in which the oil is suspended by the agency of the gum, sugar, and albumen. This emulsion, as observed by Dr. Duncan, has a close analogy with milk, not only in appearance, but also in composition. When it is allowed to stand for some time, the oil rises to the surface like thick cream; and the separation is effected more quickly by heat, alcohol, and the acids, which coagulate the albumen. In hot weather, it very quickly becomes sour, and unfit for use. The most important constituent of sweet almonds is the fixed oil, which merits a brief notice.

Oil of Almonds.—Oleum Amygdalæ, U. S. Ph.—*Huile d'amandes*, Fr.; *Mandelöl*, Germ. This is obtained by expression from sweet almonds, previously bruis-

ed, or ground in a mill. It is said that almonds produced in a cool climate, yield less than such as grow in warmer latitudes, and that after having been dried, they are more productive than when fresh. An equally pure oil may be procured from bitter almonds, if expressed without heat; but if heat is used, the product is apt to be contaminated with the volatile oil, containing hydrocyanic acid. The kernels are sometimes blanched before expression, and in this state yield the oil more free from colour. Sweet almonds are much more productive than the bitter. M. Boullay obtained 54 per cent. of oil from the former; while to Vogel the latter afforded only 28 per cent. The oil of almonds is a clear, colourless, or yellowish liquid, nearly inodorous, and of a bland, sweetish, agreeable taste. It remains liquid at a temperature considerably below the freezing point of water. Its sp. gravity varies from 0.917 to 0.92 at 59°. When properly prepared, it keeps long without change.

Preservation of almonds, signs of quality, &c.—Almonds should have been originally well dried, and should be kept in a dry place; as they are apt to become rancid when moist. With due care, they may be kept two or three years in a sound state. They are very liable to the attacks of insects. In selecting them for medical use, care should be taken to reject those which are much shrivelled, worm-eaten, brown or yellowish internally, or of a rancid taste or smell.

Medical and economical uses of sweet almonds, and of almond oil.—Sweet almonds exercise no very decided influence over the system. In the state of emulsion, they form a very agreeable demulcent drink, in catarrhal affections, dysentery, inflammation or irritation of the urinary passages, and in febrile complaints generally. To be useful, however, the emulsion must be taken freely. It is also an excellent vehicle for other medicines, particularly in pectoral complaints; but any considerable quantity of tinctures, or of acidulous substances, should not be mixed with it, as they coagulate the albumen. Almonds are very pleasant to the taste, particularly in their recent state, and are much used as an article of diet in countries where they can be readily obtained; but unless well chewed, they are of difficult digestion, and are not wholesome when eaten in large quantities. It is said, that taken six or eight at a time, they sometimes afford relief in heart-burn. The mass which remains after the expression of the oil, is employed as a cosmetic to soften the skin of the hands and face.

Almond oil is a gentle laxative, like olive oil, and may be used for similar purposes, whether as an article of diet, or as a medicine. Formed into an emulsion with gum Arabic, loaf-sugar, and water, it may be given advantageously in catarrhal and slight dysenteric affections. As a laxative, the dose is one or two *fluidounces;* as a demulcent, a *fluidrachm* or more. It is much used, especially in France, in the preparation of mild unguents, intended as external applications to soften the skin, and to protect abraded or irritated surfaces from the action of the air.

Preparations of sweet almonds, and of almond oil.——A confection of almonds (*Confectio Amygdalæ*, U. S. Ph.) is directed in the U. States and London Pharmacopœias, prepared by beating together blanched almonds, powdered gum Arabic, and loaf-sugar. It is used only in the preparation of the almond mixture (*Mistura Amygdalæ*, U. S. Ph.), made by rubbing up the confection with water, and straining. The *almond emulsion*, frequently called *almond milk*, may be extemporaneously prepared by triturating blanched almonds in a marble mortar with boiling water gradually added, and straining. The proportions may be an ounce of the almonds to a pint of water; and sugar and gum Arabic may be added if deemed advisable. The *syrup of orgeat* is a concentrated almond emulsion, made into a syrup with sugar, and flavoured with some aromatic, as the distilled water of orange-flowers, and the oil of lemons. The sweet and bitter almonds are both employed in its preparation, in the proportion of two parts of the former to one of the latter. The composing and anodyne properties which it is said to possess, are undoubtedly ascribable to the hydrocyanic acid of the bitter almonds.

The most common preparation of almond oil is the ointment of rose-water (*Unguentum Aquæ Rosæ*, U. S. Ph.), made by melting together almond oil, spermaceti, and white wax, and incorporating the mixture with rose-water. The unguent sold in the shops under the name of *cold cream*, is an equivalent preparation.

2. Bitter Almonds.—*Amygdalæ Amaræ*, Officin.—*Amandes Amères*, Fr.; *Bittere Mandeln*, Germ. These are derived from the variety *amara* of the *Amygdalus communis;* and are said to be brought chiefly from Morocco. They are usually smaller than the sweet almonds. When perfectly dry, they are nearly inodorous; but by being rubbed with water, acquire a smell like that of the peach blossom. Their taste is bitter, like that of the peach kernel.

They contain, according to Vogel, the same constituents as those found by Boullay in sweet almonds; and in addition, afford, when distilled with water, a peculiar volatile oil combined with hydrocyanic acid. It was formerly thought that this oil preexisted in the almonds; but it has been rendered probable by the experiments of Robiquet and Boutron-Charlard, that it is formed by the reaction of water on a peculiar principle contained in bitter almonds; for when these are deprived of their fixed oil by expression, and afterwards submitted to the action successively of alcohol and water, they do not yield a particle of volatile oil to either of these fluids. But a peculiar substance, called *amygdalin*, is dissolved, under these circumstances, by the alcohol; and it is from this that the volatile oil is supposed to be formed by the reaction of water, when the almonds are submitted to distillation. Upon this oil and the hydrocyanic acid associated with it, whether preexisting in the oil, or formed by the agency of the liquors of the stomach, bitter almonds depend for their peculiar medicinal effects. *Amygdalin* is a white crystallizable substance, inodorous, of a taste at first sweetish and afterwards bitter, unalterable in the air, soluble in alcohol, and insoluble in ether.

Volatile oil of bitter almonds.—This is obtained by distillation with water from bitter almonds, previously deprived of their fixed oil. It is recommended that the mass which remains after expression, should be suspended, during the process of distillation, over the surface of the water in the boiler, so that it may be penetrated by the steam without mixing with the water itself. The liquor which first comes over is clear, but the latter portions are milky, and hold a considerable quantity of the oil in solution, in consequence of the presence of a substance which increases the solvent power of the water. It is necessary, therefore, to re-distil the liquor obtained. Almost all the oil now comes over with the first portions of water, and sinks to the bottom of the vessel. The product is exceedingly small, not exceeding two ounces, or two and a half ounces, from one hundred weight of the cake. (*A. T. Thomson, Dispensatory.*) The volatile oil of bitter almonds has a yellowish colour, the peculiar odour of the kernels, and a bitter, acrid, burning taste. It is heavier than water, in which it is very slightly soluble, and dissolves freely in alcohol and ether. Upon standing, it deposits a white, crystalline substance, consisting chiefly of benzoic acid, which does not exist in the oil, but is formed, as proved by Robiquet and Boutron-Charlard, by the reaction of the atmospheric oxygen. The oil contains a considerable quantity of hydrocyanic acid, which it holds with a strong affinity, as the acid is not extracted by water, and the alcoholic solution of the oil does not afford a blue precipitate with the salts of iron; but when treated with a solution of potassa, or with baryta water, the oil yields the acid to the alkaline base, and loses its poisonous properties. MM. Wöhler and Liebig, by mixing the oil carefully with hydrate of potassa and a solution of muriate of iron, strongly agitating the mixture, and then distilling, succeeded in obtaining it entirely free from hydrocyanic acid. In this state it is colourless and limpid, retaining its original odour, and having a burning, aromatic taste. Its specific gravity is 1.043, and its boiling point 266° Fah. By exposure to the atmospheric air or oxygen gas, it is converted into benzoic acid.

The hydrocyanic acid contained in the oil of bitter almonds, is much less disposed to spontaneous decomposition than the same acid dissolved in water or alcohol. Indeed, if the oil be kept in well-stopped bottles, it will preserve its acid unchanged for several years. It might, therefore, be advantageously substituted for the officinal preparations of hydrocyanic acid; as it acts upon the system precisely in the same way, and, from its greater uniformity, must be much more certain in its effects, and more easily regulated as regards the dose.

Other oils, similar in character to that of bitter almonds, may be obtained by distillation with water from the leaves of the peach and cherry-laurel, the bark of the *Prunus Padus*, and probably from many other substances possessing the same peculiar odour and taste. Among these is the kernel of the peach, which appears to possess properties nearly identical with bitter almonds, and is used for similar purposes. The odour of these oils has been erroneously ascribed to the hydrocyanic acid. It is entirely distinct from that of the acid, and exists in the oils when deprived of this principle.

Effects of bitter almonds, and their volatile oil on the system. Toxicology.—Bitter almonds act on the system in a manner analogous to hydrocyanic or prussic acid. In moderate quantities, they diminish nervous excitability, and relieve irritation, without in general producing unpleasant effects. More freely taken, they evince decided narcotic powers, giving rise to vertigo, pain or uneasiness in the head, and various other symptoms dependent on cerebral or nervous disorder. They are, more-

over, apt to derange the stomach, occasioning distress in the epigastrium, nausea, vomiting, and sometimes diarrhœa; effects which may be ascribed partly to their indigestible nature, partly to the hydrocyanic acid which they contain or evolve. In very large quantities they act as a violent narcotic poison; and instances of dangerous and even fatal effects from their use are on record. Half an ounce of bitter almonds, eaten by an individual in the morning before breakfast, produced at the end of half an hour, severe pain in the head and nausea, which disappeared after three hours, without other unpleasant consequences. (*Bull. des Sciences Méd., Juillet*, 1828.) A naturalist, after having eaten four ounces, was seized with all the symptoms of a violent narcotic poison, which would probably have terminated fatally, but for the prompt assistance which was rendered. (*Dict. de Mat. Méd.* I. 264.) A stout labourer was seen to fall suddenly, while standing near a wall, and was found, upon the arrival of a medical practitioner, insensible and without pulse, while his breath exhaled the odour of bitter almonds. Upon examination after death, a large quantity of these almonds were discovered in his stomach. (*Lond. Med. and Phys. Journ.* LVII. 150.) Other cases, either alarming or fatal, are recorded in the periodical journals. Happily, the emetic effect which is apt to ensue from the very free use of the almonds, diminishes the danger, by removing the offending cause. In some constitutions, bitter almonds, even in very small quantity, give rise to urticaria. Among the individuals affected in this way by them, was the late Dr. Gregory of Edinburgh, in whom they produced at first nausea and vomiting, and afterwards a fit of the nettlerash, attended with swelling of the head and face, and a feeling like that of intoxication. (Christison *on Poisons*, p. 576.) Injurious consequences sometimes result from partaking freely of cakes, sweetmeats, or *liqueurs*, in which they have been used by the confectioners too largely for the sake of their flavour. In the inferior animals, bitter almonds produce the same dangerous effects as in men. The symptoms attending their action are, trembling, weakness, convulsions, palsy, and coma. Sometimes they vomit, in which case the unpleasant symptoms are averted or removed. According to Orfila, twenty almonds, introduced into the stomach of a dog, will cause death in six hours, if the œsophagus be tied. Fatal consequences also result from their application externally to wounds.

The *distilled water of bitter almonds* is much more powerful than the almonds themselves. Dr. A. T. Thomson, in his Dispensatory, states, that in the dose of thirty drops, it produces vertigo, headach, or a sense of weight at the top of the head, tinnitus aurium, dizziness, and vomiting; and that a drachm of it has killed a stout dog.

The *volatile oil* is in the highest degree poisonous. Mr. Brodie, while experimenting upon animals, simply touched his tongue with the end of a probe which had been dipped into the oil, and immediately experienced a very peculiar and unpleasant sensation in the epigastrium, with a feeling of weakness in the limbs, as though he was about to fall. These symptoms were renewed upon a subsequent application of the poison in the same way; but in both instances the effects were only momentary. One drop of the oil applied to the tongue of a cat, produced death in five minutes, preceded by violent convulsions. The same consequences resulted, in the same length of time, in another cat, from the injection of two drops into the rectum. (*Philosoph. Transact.* 1811.) Four drops killed a dog of middling size. Mertzdorff relates the case of a gentleman who took two drachms of the oil. A few minutes afterwards, he was found lying in bed, with spasmodic contractions of his features, fixed upturned eyes, and convulsive movements of the chest. Twenty minutes after the draught had been taken, he was quite insensible, with immovable pupils, slow and stertorous breathing, and a feeble pulse, beating only 30 strokes in a minute. His breath exhaled a strong odour of bitter almonds. Death occurred ten minutes afterwards. (Christison *on Poisons*, p. 577.) The appearances after death from bitter almonds, or the volatile oil, are the same as those from hydrocyanic acid. The blood remains fluid, the venous system is everywhere turgid, the stomach and bowels are usually reddish, the whole body exhales an odour of bitter almonds; and a singular phenomenon is, that the eyes are glistening and staring, as if the person were alive. The redness of the stomach is not invariably present; and from all the phenomena, the inference is plain, that the force of the poison is expended on the nervous system. Brodie found the heart beating several minutes after respiration had ceased, and the animal was apparently dead. The oil must consequently have acted through the brain. The measures proper in a case of poisoning by bitter almonds, or their volatile oil, are, evacuation of the stomach, the

internal use of ammonia and other diffusible stimulants, and inhalation of ammoniacal vapours, or chlorine in a proper state of dilution. Should respiration have ceased, it would be proper to reproduce and support it artificially, as the heart does not cease to beat for some time after apparent death; and by sustaining the respiration, life may possibly be preserved, as proved by BRODIE in the case of some other narcotics, till the violent effects of the poison shall have been expended.

Therapeutical application of bitter almonds and their volatile oil.—The diseases to which these remedies are applicable, are the same with those for which hydrocyanic acid is employed; such, namely, as either consist in undue nervous excitement, general or local, or are attended with such excitement, in other words, diseases of irritation. The almonds themselves unite demulcent with their sedative properties, and are therefore especially suited to complaints of the lungs, attended with spasmodic cough, or general irritation of the system. The emulsion of bitter almonds has been found a useful palliative in phthisis, and has been recommended highly in whooping-cough, and asthmatic affections. It is said also to have proved advantageous in dyspepsia. BERGIUS esteemed it secondary only to Peruvian bark in intermittents, and succeeded with it in some cases in which this remedy had failed. He dissolved two drachms of tartrate of potassa and an ounce and a half of honey in a pint of water, and with this solution prepared an emulsion with an ounce of bitter almonds. He gave one or two pints of the emulsion daily during the intermission. (CULLEN's *Mat. Med.*) HUFELAND recommends the almonds to be taken in substance, shortly before the expected return of the paroxysm. MYLIUS, first physician of the Marine Hospital at St. Petersburg, found them the most effectual of all the substitutes for cinchona, which he had tried during a practice of thirty-three years. He prescribed an emulsion, made with a drachm and a half or two drachms of the almonds and three ounces of water, to be taken at one dose an hour before the paroxysm; and in this way succeeded in curing seventeen patients, during two months, with from three to eleven doses of the medicine. (*Dict. Univ. de Mat. Med.*) Bitter almonds have also been employed as a vermifuge, and have been recommended by some German physicians in tænia. By the ancients, they were thought to possess the property of diminishing or qualifying the intoxicating properties of wine; but this opinion appears to have been without foundation. Dr. A. T. THOMSON has found the emulsion extremely beneficial when used as a lotion in acne rosacea and impetigo. The water of bitter almonds has sometimes been employed, but is at present out of use. The volatile oil, though very seldom prescribed, would probably be found an excellent substitute for hydrocyanic acid, the effects of which it is capable of exercising on the system, without being equally liable to the objection of variable and uncertain strength. The author has recently employed it in a case of diseased heart, with the apparent effect of moderating the pulsations, and affording relief to the patient.

Bitter almonds should not, as a general rule, be given in substance, as, in consequence of the difficulty of their digestion, they might prove offensive to a delicate stomach. An emulsion, made in the proportion of an ounce of the kernels to a pint of water, with two drachms of gum Arabic and half an ounce of sugar, may be given in pectoral affections, in the dose of from half a fluidounce to two fluidounces every three or four hours. Of the volatile oil, not more than one-sixth or one-quarter of a drop should be given at first, to be increased very gradually, and suspended if found to produce vertigo, headache, nausea, or other unpleasant symptoms. It may be administered in emulsion with gum Arabic, loaf-sugar, and water.

Bitter almonds and the volatile oil, are much used, particularly in Europe, to flavour cakes, sweetmeats, syrups, and liquors. In this country, the kernel of the peach, which possesses analogous properties, is often substituted.

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GEO. B. WOOD.

ALNUS. ALDER. *Aune*, *Aulne*, Fr.; *Erle*, *Eller*, Germ.

Sex. Syst. Monœcia Tetrandria.—*Nat. Ord.* Betulineæ.

Gen. Ch. MALE. *Ament* composed of cuneiform, truncated, three-flowered receptacles. *Calyx* a scale. *Corolla* four-parted. FEMALE. An *ament.* *Calyx*, scales two-flowered. *Corolla* none. *Seeds* compressed, ovate, naked. WILLD.

This genus, which is not numerous, was separated from the Betula of LINNÆUS.

Only two species, the *A. glutinosa* and *A. serrulata*, have attracted attention as affording medicinal products.

1. *A. glutinosa*, Willd.—*Betula Alnus*, Linn.—*Common European Alder.*—*Sp. Ch.* "Leaves roundish-cuneiform, obtuse, somewhat retuse, glutinous, villous in the axils of the veins beneath." Willd. This is a tree of rather slender form, but often of great height, growing in swamps, moist woods, and other low wet places, throughout Europe, in Asia, in the north of Africa, and in the northern parts of North America. The bark and leaves are very astringent and somewhat bitter. The former has been used in intermittent fever, the latter as an external application to wounds and ulcers. The fresh leaves are sometimes bruised and applied to the breast, for the purpose of repelling the milk. The fruit is also astringent, and is said to be useful as a gargle in sore throat. All these parts of the tree have been employed in dyeing, and the bark and leaves in tanning. The wood answers an excellent purpose in all works intended to be constantly under water.

2. *A. serrulata.* Willd.—*Common American Alder.*—*Sp. Ch.* "Leaves obovate, acuminate, with the veins and the axils of the veins hairy beneath, stipules oval, obtuse." Willd. This is a shrub from six to ten feet high, growing throughout the United States, in close thickets, in swamps, and on the sides of streams. It is analogous, in medical properties, to the former species, and may be employed for the same purposes. Geo. B. Wood.

ALOE. (*Botany.*)

Sex. Syst. Hexandria Monogynia.—*Nat. Ord.* Asphodeleæ.

Gen. Ch. *Flower* tubular, with a six-cleft, spreading mouth, and honey at the bottom of the tube. *Filaments* inserted into the receptacle. *Capsule* three-celled, three-valved, many-seeded. *Seeds* in two rows, with a membranous edge. Lindley.

The plants of this genus, amounting, according to Lindley's enumeration in the Encyclopædia of Plants, to ninety-nine in number, are perennial, evergreen succulents, having, in some instances, the character of trees or shrubs, but in general presenting an herbaceous aspect. Some are furnished with a stem, which is usually round and simple; others are stemless, sending up their leaves and flower-stalks directly from the root. The leaves are thick, fleshy, succulent, sometimes unarmed, sometimes thorny on the margin, smooth or warty, and of a green colour, occasionally painted, or diversified with spots. The flowers, which are often showy and beautiful, are supported, in the form of spikes or racemes, upon usually long, sometimes branching, scapes or peduncles. All the species, upon being wounded, yield a juice, which is generally bitter and purgative, and, in a concrete state, constitutes the drug known by the name of aloes. (See *Aloes.*) From which of the species the aloes of commerce is actually derived, has not been determined with entire precision. In the Pharmacopœia of the United States, and in that of the London College, the *A. spicata* only is recognized. The Dublin College adopts as officinal both this and the *A. vulgaris;* while the Edinburgh College refers the drug to various species of Aloe, without designating any one in particular. It is probable that the *A. Soccotrina*, *A. spicata*, and *A. vulgaris*, yield most of the aloes at present employed; and to these, accordingly, we shall chiefly confine our attention, merely noticing others which have been mentioned by writers as contributing to furnish the medicine. The aloe plants are all natives of warm climates, and most of them of the Cape of Good Hope. They prefer a light, sandy soil.

1. *A. Soccotrina.* Haworth.—*A. vera*, Miller.—*A. perfoliata*, variety ξ, Linn.—*Sp. Ch.* "Leaves oblong-ensiform, somewhat spotted; edges cernuous, white, with straight spines." Lindley. This species is shrubby, with a stem three or four feet high, bearing at its summit numerous crowded, embracing leaves, disposed without regular order, and a foot or eighteen inches long. Sometimes the stem branches into two, three, or four of these leafy heads. The flowers, which are of considerable size and of a beautiful scarlet colour, are disposed in the form of a close, cylindrical raceme, at the end of an erect peduncle, which rises eighteen inches or two feet from the top of the stem. The plant is a native of the island of Socotora, of the neighbouring parts of Arabia and Africa, and of the Cape of Good Hope. It is probably the source, at least in part, of the variety of aloes called Socotrine.

2. *A. spicata*, Willd.—*Sp. Ch.* "Leaves lorate-ensiform, downward, spotted with white; marginal spines middle-sized, red." Lindley. The stem of the spiked aloe is three or four feet high, about as thick as a man's arm, and leafy at the summit. The leaves, which are disposed in a somewhat verticillate order, are broad at the base, gradually narrowing to a point, about two feet long, channelled, acute, and with remote teeth. The flowers are in very close

spikes, which spread horizontally. The corolla is bell-form, almost six-petaled, with the three inner segments unconnected, ovate, obtuse, and of a white colour marked with three green lines, the three outer connected with the others at their base, narrower, and less concave. The species is distinguishable by the spikes and by the form of the flowers. It was first described by THUNBERG, who found it growing at the Cape of Good Hope. It is said to be especially abundant in the district of Zwellendam, near Mossel Bay, where great quantities of aloes are collected. The best Cape aloes is derived from this species. The statement made by some writers that it affords the Socotrine aloes, is probably incorrect; as this does not come from the Cape of Good Hope, and is wholly different in appearance from the drug obtained from that part of Africa.

3. *A. vulgaris*, DE CANDOLLE.—*A. perfoliata*, variety *π*, LINN.—*A. Barbadensis*, MILLER.——*Sp. Ch.* "Leaves somewhat spreading ascending, with spines on the edges; peduncles branching, branches embraced by a double bracte." DE CANDOLLE. In the common aloe, the stem is ligneous, simple, about four inches high, and concealed by the leaves, which embrace it at their base. The leaves are numerous, lanceolate, three or four inches broad at the base, a foot or eighteen inches long, turned upwards from the middle, flat on the upper surface, convex beneath, with hard spines at the edges, and without spots. The flower-stalk rises from the midst of the leaves, and divides into three, four, or five branches, which bear yellow flowers at their summit, disposed in oval cylindrical spikes. The corolla is cylindrical and full of a sweet juice. This species grows wild in Syria, Greece, and Spain, and has been introduced into the West Indies. It yields a variety of hepatic aloes, sometimes called Barbadoes aloes, from the island where it has been most abundantly produced. The poorest soils, unfit for sugar or other valuable crops, are selected for its cultivation.

In addition to the above-mentioned species, the *A. arborescens*, *A. Commelini*, *A. dichotoma*, *A. Lingua* (*A. linguæformis*, LINN. suppl.), and *A. purpurascens*, have been particularized as contributing to furnish the aloes of commerce. They are all natives of the Cape of Good Hope. The *A. arborescens* and *A. purpurascens*, which, as well as the *A. Socotrina* and *A. vulgaris*, above described, were included in the *A. perfoliata* of LINNÆUS, are said to be cultivated for the sake of their product in the West Indies. The *A. arborescens* is one of the largest species, with a stem ten or twelve feet high, and having in some measure the appearance of a tree.

In the countries where the aloe plants grow spontaneously, cordage and a coarse kind of cloth are sometimes manufactured out of the fibres of the leaves; and the prickly species are used for hedges.

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ALOES. (*Mat. Med.*) ALOE, U. S. Ph.; *Aloës spicatæ extractum*, L. Ph.—*Aloès*, Fr.; *Aloe*, Germ.

This is the inspissated juice of different species of Aloe. (See *Aloe.*) It is prepared in various ways in different countries, and according to the desired quality of the drug. The best aloes is procured by inspissating, with the heat of the sun, the juice which flows spontaneously from the leaves when cut. Sometimes the plant is submitted to pressure; but the resulting product must, in this case, be inferior, as the internal portion of the leaves consists, according to the observation of MURRAY, of an inert mucilaginous pulp, while the bitter juice is contained exclusively in vessels running longitudinally beneath the epidermis. Extraction by boiling water, which is also occasionally employed, yields a still feebler and impurer product. Inspissation by artificial heat, though generally practised, is injurious to the aloes; as a portion of it, when exposed to the air at a high temperature, becomes insoluble and inert. The volatile oil, moreover, is driven off by boiling; and the medicine, prepared in this way, has less aroma than when it is obtained by the spontaneous evaporation of the juice.

Commercial History and Varieties.—Three varieties of aloes are known in the markets of this country—the *Cape*, the *Socotrine*, and the *hepatic*—to which may be added the *caballine*, *fetid*, or *horse* aloes, which, though not at present employed, is described in most works upon Materia Medica. Each of these merits a distinct notice.

1. CAPE ALOES. This variety, which derives its name from the Cape of Good Hope, where it is produced, is by far the most abundant, and, when of good quality, is quite equal in medicinal power to the

Socotrine, with which in fact it is confounded by many writers, though wholly distinct in its appearance. By the German writers it is called *aloe lucida*, or *shining aloes*, from the brilliancy of its surface. The name is very appropriate; though it belonged previously to another variety, produced by spontaneous exudation and inspissation upon the leaves of the plant, and existing in the form of tears. This, however, is at present unknown in commerce. Cape aloes is supposed to be derived chiefly from the *Aloe spicata.* THUNBERG states, that the Hottentots cut off the leaves, and arrange them so that the lowest serves as a gutter to convey the juice into a calabash, in which it is afterwards inspissated, by being brought near the fire. But this process is too slow to afford the aloes at so cheap a rate as it is now found in the market. The plan said to be followed at Zwellendam, is to express the juice from the leaves, previously cut in pieces, and to inspissate it in boilers, over the fire. When of a proper consistence, it is introduced into chests or casks, and sent into the market. We obtain it in this country through the ports of England, whither it is sent from the Cape.

As found in the shops, it is in irregular, angular fragments, of various sizes. It has a very dark olive colour, approaching to black, and when freshly broken presents a smooth, shining, glossy surface, which is one of its distinguishing characters. When held up to the light, it usually appears somewhat translucent at the edges. The small fragments also are translucent, and have a tinge of yellow or red, mixed with the deep olive of the opaque mass. A similar tinge is sometimes observable in the larger pieces, especially when they are penetrated with small cracks, or fissures. The powder is of a fine greenish-yellow colour, and being generally more or less sprinkled over the surface of the pieces, gives them, as found in the shops, a yellowish, somewhat dusty appearance externally. Cape aloes, when perfectly hard, is very brittle, and easily pulverizable, breaking with a smooth, glassy fracture, with sharp edges. In hot weather, it is apt to be somewhat soft and tenacious; and the interior of the pieces is occasionally more or less so even in winter; but by long keeping and exposure, it becomes perfectly dry, and remains hard and brittle in the middle of summer. Its odour is strong and disagreeable, but not nauseous, and has not the slightest mixture of the aromatic.

2. SOCOTRINE ALOES.—This received its name from the island of Socotora, in the Straits of Babelmandel, in which it has been produced from a very early period, being mentioned in the writings of AVICENNA, who speaks of it as superior to the other kinds then in use. We are told, however, by AINSLIE, that the greater part of the aloes sold as the Socotrine, is prepared in the kingdom of Melinda, on the eastern coast of Africa. The species of Aloe which yields it, is not certainly known. AINSLIE says that it is from the same species as the Cape aloes; but the two varieties differ too much in appearance and sensible properties, to admit the supposition of an identity of origin, unless upon strong proof; and none such has been adduced. There does not appear to be any good reason for depriving the *Aloe Soccotrina* of the credit which it formerly enjoyed, of producing this highly esteemed variety of aloes. Dr. A. T. THOMSON tells us, in the London Dispensatory, upon what authority is not stated, that in the process of preparing aloes, in the island of Socotora, the juice, having been expressed from the leaves previously cut in pieces, is allowed to rest for forty-eight hours, in order that the feculent matter may subside, and is then poured off into flat dishes, and evaporated in the sun. When sufficiently hard, it is placed in skins, and exported. A portion reaches Europe by the route of the Red Sea; another portion is sent to Bombay, and other Indian ports, and thence shipped to different parts of the world. We obtain our supplies chiefly from London, though occasionally an American vessel touches at the place of production, and the author has seen a parcel of aloes which came directly from Socotora.

But the name of Socotrine aloes is not confined to the product of this island exclusively; it is also applied to parcels of the drug from other sources, prepared with unusual care, and resembling it in quality. Thus in the West Indies, according to Dr. BROWNE (*Browne's Jamaica*, p. 198) and Mr. MILLINGTON, (*Lond. Med. Journ.* VIII. 422,) the juice which flows out from the leaves when cut off from the plant, is sometimes inspissated by exposure to the sun in shallow vessels, or bladders hung up in the open air, and in this state is called *Socotrine* aloes; while that prepared by boiling the juice, is called *hepatic.* M. JUSSIEU witnessed at Morviedro, in Spain, the preparation of three varieties of aloes, from the *A. vulgaris*,—the *Socotrine*, by incision and spontaneous evaporation, the *hepatic* by expression, and the *caballine* by still stronger pressure. (REES' *Cyclopædia.*)—Even in the East, whence the genuine So-

cotrine aloes is procured, the inferior variety denominated hepatic, is also prepared, probably from the same plant; and it may be considered that these terms are applicable rather to different qualities of the drug than to distinct products obtained from wholly different sources.

Socotrine aloes is in pieces of a yellowish or reddish-brown colour, which becomes much darker by exposure to the air, but is always wholly different from that of the first variety. Its surface is somewhat shining, and its fracture usually smooth and conchoidal, with rather sharp and semi-transparent edges. The colour of its powder is a bright golden yellow. It has a peculiar, not unpleasant odour; and a taste, which though bitter and disagreeable, is accompanied with an aromatic flavour. Though hard and pulverulent in cool weather, it is somewhat tenacious in summer, and softens with the heat of the hand.

3. Hepatic Aloes.—Hepatic aloes is prepared in the West Indies and Spain, and is also brought from the East Indies. According to Ainslie, it is not produced in India, but is taken thither from Yemen, in Arabia. It is probably derived from the same source as the Socotrine, but prepared with less care, or by a different process. In Spain it is procured from the *Aloe vulgaris.* That obtained from the West Indies, which is most abundant in the markets of Europe, is sometimes called *Barbadoes aloes*, from the island in which it is most largely produced. Both in Barbadoes and Jamaica, the aloe plant is cultivated to a considerable extent in the poorer soils. The species which yields most of the aloes from the West Indies, is said to be the *A. vulgaris*, although the *A. arborescens*, and *A. purpurascens*, and perhaps some others, are also cultivated. The process for preparing the drug, as described by Dr. Browne and Mr. Millington, consists in cutting off the leaves close to the stem, allowing them to drain in tubs, and, when a sufficient quantity of the juice is collected, evaporating it in large iron or copper boilers over a regular fire. Dr. Wright, in his account of the medical plants growing in Jamaica, (*Lond. Med. Journ.* VIII. 219,) represents the process somewhat differently. According to this author, the plant is pulled up by the roots, cut into pieces, placed in small hand-baskets or nets, and then introduced into large iron boilers with water, where it is boiled for ten minutes. At the end of this time it is removed, and its place supplied by fresh parcels, till the liquor becomes strong and black. This is then allowed to rest till it deposits its feculent parts, when the clear liquor is poured off, and evaporated in large iron vessels, rapidly at first, but more carefully towards the end of the process, in order to prevent the aloes from being burnt. When of the consistence of honey, it is poured into gourds or calabashes, and allowed to harden. It is probable that both these processes are employed; but the first would yield a better product. The best aloes is taken to Europe from the West Indies in calabashes, and the inferior sorts in casks. Very little hepatic aloes is used in the United States, except what may be brought under the name of Socotrine.

Hepatic aloes, like the Socotrine, is of a reddish-brown colour, but is darker and less glossy. Its name originated in the resemblance of its colour to that of the liver. Its odour is disagreeable and nauseous, differing wholly from that of the Cape aloes, and without the aromatic flavour of the Socotrine. The taste is nauseous and intensely bitter. The fracture is not so smooth, nor the edges so sharp and transparent as in the two first varieties. It softens in the hand, and becomes adhesive. The powder is of a dull reddish-yellow, or olive-yellow colour.

4. Caballine Aloes.—The *caballine* or *horse* aloes, sometimes called *fetid aloes*, from its odour, is a very impure variety of the drug, procured from the dregs of the juice deposited during the preparation of the more valuable varieties. It is black, heavy, opaque, and of an offensive odour, and, in consequence of the sand and other impurities which it contains, breaks with a rough fracture. It is employed only for horses, whence it derived its name. In this country it is scarcely known.

General properties and composition.—The odour of aloes is different in the different varieties. The taste is in all intensely bitter, and very adhesive. The colour, and other sensible properties, have been already described. The chief constituents of aloes are a *bitter principle* soluble in water and officinal alcohol, in which the virtues of the medicine reside; and another substance, in much smaller proportion, which is inodorous, nearly tasteless, insoluble in cold water, scarcely soluble in boiling water, but very soluble in alcohol. The bitter principle is generally considered a peculiar modification of extractive matter; the substance insoluble in water, has by some been called a resin, but is thought by Berzelius to be nothing more than the extractive rendered insoluble and inert by the agency of atmospheric air,

during the evaporation of the juice. Besides these principles, vegetable albumen has been detected in the *hepatic* aloes, and a minute quantity of volatile oil has been obtained from the *Socotrine* by distillation. The proportion of the ingredients varies in the different varieties, and even in different specimens of the same variety. The Socotrine aloes yielded to BRACONNOT 73 per cent. of the bitter principle; to TROMMSDORFF 74.4 per cent.; to BOUILLON LAGRANGE and VOGEL 68 per cent., and to WINKLER only about 50 per cent.; while from 100 parts of hepatic aloes TROMMSDORFF obtained 81.25 parts of the bitter principle, BOUILLON LAGRANGE and VOGEL 52 parts, and WINKLER 60 parts. It is by no means certain, however, that the specimens of aloes operated on by these chemists, were actually of the varieties to which they were respectively supposed to belong; and the only practical inference to be drawn from the experiments, is, that the average proportion of the active principle in the different kinds of aloes is about 65 per cent. This principle, though soluble in officinal alcohol, which contains water, is insoluble in absolute alcohol. The colour of its aqueous solution is rendered lighter by the acids, which occasion a slight precipitate. The alkalies and the persalts of iron render it dark red. The protomuriate of tin and the nitrates of silver and mercury occasion precipitates. (BERZELIUS.)

Aloes yields its active matter to cold water, and with the exception of impurities, is almost wholly soluble in boiling water, which, however, lets fall the resinous matter or altered extractive when it cools. It is also soluble in ordinary officinal alcohol, and in proof spirit or diluted alcohol. Long boiling impairs its virtues by facilitating the action of the air upon the extractive, and thus increasing the proportion of the insoluble ingredient. The alkalies, their carbonates, and soap, render it more soluble in water, by acting upon the resinous matter or altered extractive, which is readily dissolved by alkaline solutions. They also modify, in some measure, the character of the active ingredient. Aloes is inflammable, swelling up and decrepitating when it burns, and emitting a thick smoke, which has the odour of the drug. Its watery solution may be kept for a long time without becoming mouldy or putrescent; but it assumes a mucilaginous consistence, and acquires the character, not originally belonging to it, of affording an abundant precipitate with the infusion of galls.

Effects upon the system.—There is no essential difference in the mode of operating of the different varieties of aloes. The Socotrine is the least disagreeable to the taste and smell, but in other respects is not superior to the Cape aloes, which is, indeed, very often sold for it, and in this country is generally used.

Aloes is a warm, somewhat stimulant cathartic, acting very slowly, and exerting its effects chiefly upon the large intestines. It seldom operates in less than six or seven hours, and sometimes not under twenty-four. The usual period is, perhaps, from eight to twelve hours. In small doses of two or three grains, it usually acts as a gentle laxative, discharging, at a single operation, the fecal contents of the lower bowels with little pain or uneasiness. The amount of its cathartic effect is not increased in proportion to the dose; though CULLEN went too far in stating that the effects of ten or twenty grains are much the same as those produced by one-tenth of the quantity. In a full dose, it acts both with greater certainty and efficiency; but in whatever quantity it may be taken, it seldom produces large and frequent watery evacuations. It seems rather to discharge the contents of the bowels, than to increase the secretions into them. But though the cathartic effect is not in proportion to the quantity taken, aloes in large doses produces considerable griping and irritation, especially in the rectum, and sometimes, if repeated, occasions bloody discharges, and even induces hemorrhoidal tumours. Its tendency to act upon the pelvic viscera is, indeed, one of its most striking peculiarities. Even in small doses, frequently repeated, and continued for a long time, it often excites irritation, and consequent sanguineous congestion, not only in the colon and rectum, but occasionally also in the urinary organs, giving rise to a sense of fullness and weight, or other uneasiness, in the fundament, about the region of the sacrum, and at the neck of the bladder. In females, it acts also upon the uterine system, not unfrequently producing pain in the loins and above the pubis, and either increasing the menstrual discharge if present, or restoring it if suppressed. Its emmenagogue powers have been ascribed to the sympathetic extension of the irritation of the rectum to the uterus; but there is no reason why the medicine should not be allowed to act directly on the latter as well as on the former organ. In addition to its other powers, aloes has the property, belonging to most bitter medicines, of exciting the stomach, thereby increasing the appetite and invigorating di-

gestion, when these are impaired in consequence of a deficient tone in that organ. It was formerly thought to increase the fluidity of the blood; but this opinion has been abandoned with the advancement of medical knowledge. It has been long known to produce its cathartic effects, when externally applied to an ulcerated or abraded surface. From the results of experiments made by Dr. Gerhard, (see *N. Am. Med. and Surg. Journ.* X. 155,) it appears that powdered aloes, sprinkled upon a blistered surface deprived of its cuticle, will operate on the bowels as speedily, in the same manner, and in nearly the same dose, as when taken internally.

Authors very commonly ascribe the slow operation of aloes, and its tendency to act on the lower bowels, to its difficult solubility in the gastric liquors; but the fact is, that it is not of difficult solubility; and even admitting that it were so, the explanation would not be satisfactory, as other purgatives, certainly less soluble, such as elaterium and the resin of jalap, are much more speedy in their action. Dr. Wedekind has advanced the opinion, (*Bulletin des Sc. Med. De Ferrussac*, XII. 79,) that the medicine does not act directly upon the bowels, but indirectly upon the liver, producing an increased flow of bile, which excites the intestines into motion. In support of this opinion, he adduces the slowness of its operation, the bilious nature of the stools, and the fact that, thrown into the rectum, it produces no greater immediate irritation than warm water, while it purges in the course of eight or ten hours, when time has been allowed for the extension of its action to the liver. But the bilious nature of the stools produced by aloes, is not well authenticated; and admitting the reality of its asserted manner of acting when used in the way of enema, the fact may be readily explained without supposing any especial tendency of the medicine to the liver. Agreeing with Dr. Wedekind, that the primary action of the aloes is not upon the mucous membrane of the alimentary canal, we can readily account for its peculiarities, by supposing that it enters the circulation through the absorbents, and being thus brought into contact with all parts of the body, produces obvious effects on those parts which are peculiarly susceptible of its influence, such as the lower colon, rectum, bladder, and pelvic viscera in general. Unless this mode of action be admitted, we shall be quite at a loss to account for the resemblance which its effects, when it is applied to the skin, bear to those which result from its internal use.

Therapeutic use.—Aloes was known to the ancients, and is mentioned in the works of Dioscorides and Celsus. It is at present among the cathartics most frequently employed. Its therapeutical applications are, for the most part, such as might be inferred from the account already given of its effects upon the system. The purpose to which it is most frequently and most usefully applied, is that of relieving habitual constipation, dependent upon torpor or deficient irritability of the bowels. With this view it is given in small doses, of from one to five grains, repeated daily, or as often as circumstances may call for its use. It should, as a general rule, be taken at bed-time, as the slowness of its operation will usually preclude any disturbance of rest, and a passage will be procured at a convenient time in the morning. In this way it often proves highly advantageous in chronic rheumatism, atonic gout, chlorosis, chronic palsy, and various nervous affections, relieving the inconveniencies arising from the constipated state of the bowels, without producing either local or general debility.

The union of stomachic with cathartic properties, renders it peculiarly useful as a laxative in dyspepsia, when the gastric mucous membrane is free from inflammation. Taken in the quantity of one or two grains, a short time before dinner, it will often be found to secure a regular state of the bowels, while it promotes the appetite, renders the food less oppressive to the stomach, and obviates the flatulence, so frequently a troublesome attendant upon this complaint. Aloes is, in fact, the basis of almost all those combinations which have enjoyed so much popular credit under the name of *dinner pills*.

Its extreme bitterness, and perhaps also its colour, have suggested the idea that it might resemble bile in its action, and might form a good substitute for this secretion, when deficient in the bowels, from obstruction of the gall-ducts, or torpidity of the liver. Hence, it has been thought particularly applicable to jaundice, in which constipation is attended with whitish or clay-coloured stools. The same use of it would be suggested by the theory which ascribes the purgative operation of aloes to an increased secretion of bile, resulting from its action on the liver. M. Guilemin has even employed the remedy in the epidemic cholera, with the view of re-establishing the biliary secretion, which appears to be entirely suspended in the worst forms of

that complaint. (*Considérations sur l'amertume des végétaux. Thèses de Paris*, 1832, No. 241.) But even admitting that aloes really acts on the liver—an opinion which remains yet to be proved—we have, in the mercurial preparations, means so much more efficient for the end in view, that we should not be justified in relying upon the former medicine. It may often, however, be advantageously combined with calomel, or the blue pill, in cases of constipation with deficiency of bile.

The tendency of aloes to act especially on the viscera of the pelvis, gives it advantages as a laxative in amenorrhœa, which are possessed in an equal degree by no other cathartic medicine. Its emmenagogue virtues have been long and generally known. It is an ingredient in most of the numerous compounds popularly employed in obstruction of the menses, and is not less used in regular than in domestic practice. The cases to which it is best adapted, are those in which a deficient energy in the uterus is united with constipation of the bowels, and more or less general debility. In such cases, it is often advantageously combined with myrrh and the carbonate of iron. It should be given daily, in small doses, and continued for one or two months, or even longer, unless the object in view should be previously attained. Advantage may sometimes result in amenorrhœa from full purgative doses of aloes about the period at which the menstrual effort should occur. The medicine should not be employed in those cases of the disease in which the suppression depends upon inflammatory excitement of the uterus or a plethoric condition of the system, nor in such as are complicated with actual hemorrhoidal discharges or a strong tendency to them; as, in the former, it will be likely to aggravate the inflammation, and, in the latter, by increasing or bringing on the flow of blood from the rectum, to divert it injuriously from the womb.

With a view to its full purgative action, aloes may be given with advantage in diseases of debility, such as typhus fever and malignant scarlet fever, whenever an indication for efficient catharsis exists. Evacuating chiefly the contents of the bowels, and producing little increase of secretion from the blood-vessels, it is less liable than most other cathartics to produce exhaustion. Sometimes, indeed, it acts as a general stimulant, increasing both the force of the circulation and the temperature of the body. For the same reason it may be employed in chorea and marasmus, in which a combined purgative and tonic effect is often indicated. (See *Hamilton's work on purgative medicines.*)

The purgative action of aloes is also indicated in complaints not of an acutely inflammatory character, in which it is desirable to establish a revulsion towards the lower bowels. This is particularly the case in all instances in which the affection to be relieved has arisen from the suppression of hemorrhoidal discharges, or the cure of hemorrhoidal tumours. In obstinate head-aches and other forms of cerebral irritation not connected with general excitement, in slight or commencing pulmonary affections, and in complaints of the liver and spleen, aloes often does good, when given so as to excite irritation of the rectum, or hemorrhoids, either by full doses occasionally repeated, or by small doses given frequently and continued for a long time. As a remedy in tumid spleen it is highly recommended by Dr. Bree, who, having noticed the manifest relief afforded in a case of dyspnœa with pain in the left side, by a free hemorrhoidal discharge, imitated this process of nature by the use of aloetic aperients, with complete success. (*Medico-Chirurgical Transactions.* Vol. II. No. 1.) Hufeland speaks favourably of aloes in scrofula, attended with an insensible or atonic condition of the large intestines.

The medicine has also enjoyed some reputation as an anthelmintic, and is said to be peculiarly useful in ascarides, which inhabit that portion of the intestines upon which it acts with greatest energy. It has been employed both internally, and in the form of plaster or cataplasm applied externally over the abdomen. Its anthelmintic virtues, however, are denied by some writers, who appeal to the fact stated by Redi, that lumbrici were observed to retain life during four days in a very bitter solution of aloes. The probability is, that its power of expelling worms is limited to its purgative operation, and to its influence in restoring a healthy tone to the bowels, unfavourable to the existence of these parasitic animals.

Aloes should not be given in acute inflammatory affections, nor in fevers of a high grade of action, unless qualified by combination with other cathartics. It is contra-indicated also in pregnancy during its advanced stages, or at any stage when there is a strong tendency to abortion, in irritations or inflammations of the genito-urinary apparatus, in hemorrhoidal complaints, and during the period of menstruation. The opinion that it disposes to the

formation of piles, or aggravates them when existing, is too general, and has too long prevailed, to be without foundation. Yet testimony is not wanting to prove that it is occasionally not only harmless, but even beneficial in this complaint. Dr. CROCKETT, of Lexington, Kentucky, has derived great advantage from the use of a tincture of aloes with anise, given in small doses two or three times a day, so as to procure several soft stools. (*N. Am. Med. and Surg. Journ.* III. 193.) The fact is, that piles generally depend upon habitual constipation, and are relieved by whatever overcomes this state of bowels. Aloes removes the constipation, and may thus cure the piles, unless given in such doses, or persevered in so long, as to establish its own irritant action in the rectum. It is not, however, preferable in these cases, in any respect, to other laxatives; while its peculiar properties render it liable to produce occasional mischief. Hemorrhoidal affections sometimes depend upon a relaxed or debilitated state of the rectum; and in this case, aloes, like copaiba and turpentine, which are occasionally useful in piles, may be productive of positive advantage by irritating the part.

Aloes in the state of powder, or dissolved in alcohol, has been used as a detergent or stimulant application in foul and indolent ulcers.

Dose and mode of administration. As a laxative, the dose of aloes is from one to five grains; as a purgative, from five to fifteen grains. Much larger quantities have sometimes been given, but with the effect of producing greater irritation, without much increase of cathartic effect. The most convenient form of administration, and the one generally preferred, is that of pill, in which the unpleasant bitterness of the medicine is concealed. Some prefer the liquid form, under the impression, that, in this shape, the aloes acts more speedily and with less irritation of the rectum; but, unless modified by combination, its operation is essentially the same in whatever form it is given. When the stomach is very irritable, and objections exist to the use of the medicine in the way of enema, it may sometimes be applied with advantage, in the state of powder, to a blistered surface deprived of the cuticle.

Combination. Notwithstanding the opinion of CULLEN, that "aloes hardly receives improvement from any addition," very few medicines are employed in a greater variety of combination; and there can be no doubt that its properties are often considerably qualified in the mixture. It is asserted by M. TROUSSEAU (*Dict. de Méd.* II. 272), that aloes is rendered much less purgative by association with alcohol, and that, in the form of elixir or tincture, it must be given, in order to produce a certain effect, in a quantity twice as large as that which is requisite when the medicine is given in substance, or in any other vehicle. It has been already stated, that alkalies, alkaline carbonates, and soap, not only render aloes more soluble in water by their action upon the insoluble ingredient, but also modify in some measure the active bitter principle. The opinion is generally entertained, that they render it milder as a purgative, and less liable to irritate the rectum, while they at the same time quicken its action. Hence they are very often combined with it in prescription, and occasionally in officinal preparations. Acids are also said to modify and diminish its peculiar cathartic powers, and to have been added to some of its liquid preparations with a view to this effect. (MERAT and DE LENS, *Dict. de Mat. Med.* I. 196.) But aloes is associated not only with medicines calculated in some measure to alter its nature, but also with others having no chemical agency upon it, in order to qualify its physiological effects, or to meet coexisting indications. Thus it is frequently united with other cathartics, upon the principle that active medicines of this class become milder in combination, so far as regards the pain and irritation they produce, without losing any part of their purgative power. Hence it is an ingredient in the *compound extract of colocynth*, in the *compound pills of gamboge* of the British Colleges, and in those numerous purgative preparations which are so much used under the name of *antibilious pills.* With aromatics, aloes is frequently combined in order to cover its taste, to render it more acceptable to the stomach, and to obviate its tendency to gripe; with tonics, emmenagogues, and antispasmodics, either to increase its peculiar powers by co-operation, or to meet indications which may coexist without being incompatible with those which this purgative is calculated to answer.

Preparations. An account of aloes would be incomplete without a detail of the officinal preparations into which it enters as the chief ingredient. In relation to these, however, it is designed to make only a few general observations, the reader being referred to the Pharmacopœias or Dispensatories for the proportion of their ingredients, and the precise mode of mixing them. Some of the more common

unofficinal preparations will also be noticed.

Powder of aloes and canella.—Pulvis Aloës et Canellæ, U. S. Ph.—This powder, consisting of four parts of aloes and one of canella, has long been known under the name of *hiera picra*. It is a popular emmenagogue, and may be used for all the purposes to which aloes is applied. The canella serves merely as an aromatic. The full dose is from ten to twenty grains. The form of powder, however, is objectionable, both on account of the unpleasant taste of aloes, which is but imperfectly covered by the canella, and from its liability, in this form, to be acted on injuriously by the air, if long kept.

Compound powder of aloes.—Pulvis aloës compositus, L. Ph.—Composed of aloes, guaiac, and the compound powder of cinnamon of the London College. It is a warm stimulant cathartic, in the dose of from fifteen to thirty grains; but is little used.

Pills of aloes.—Pilulæ aloës, U. S. Ph. *Pilulæ aloëticæ*, E. Ph.—Composed of equal parts of aloes and soap. Five pills, containing ten grains of aloes, may be given as a purgative, and one, two, or three, as a laxative.

Dinner pills.—Lady Webster's pills. Pilulæ ante cibum.—Various formulæ for dinner pills have been proposed; but the following, which is given in the Paris Codex of 1758, is the most popular. "Take of the best aloes six drachms; mastich and red roses, each, two drachms; syrup of wormwood sufficient to form a mass, to be divided into pills of three grains each." One or two of these pills, taken shortly before a meal, will usually produce one free evacuation. The aloes may be considered as the only active ingredient.

Compound pills of aloes.—Pilulæ aloës compositæ, L. Ph.—Made with aloes, extract of gentian, and oil of caraway, and useful as a laxative in the costiveness of sedentary and dyspeptic individuals. The dose is from five to twenty grains, according to the degree of effect desired.

Pills of aloes and myrrh.—Pilulæ aloës et myrrhæ, U. S. Ph.—*Rufus's pills.*—Composed of aloes, myrrh, and saffron, made into a mass with syrup. These pills have been long in use as a warm stimulant cathartic in debilitated conditions of the system, attended with constipation and obstruction of the menses. The dose is from three to six pills, or from ten to twenty grains of the mass.

Pills of aloes and assafetida.—Pilulæ aloës et assafœtidæ, U. S. Ph.—Composed of equal parts of aloes, assafetida, and soap, and peculiarly useful in constipation attended with flatulence and debility of stomach. From two to five pills, each containing about four grains of the mass, may be given at a dose.

Anderson's pills.—Scots' pills.—Numerous formulæ have been in vogue for this popular preparation. The following has been adopted by the Philadelphia College of Pharmacy. "Take of aloes 787 parts, soap 131 parts, colocynth 33 parts, gamboge 33 parts, oil of anise 16 parts. Let the aloes, colocynth, and gamboge, be reduced to a very fine powder, then beat them and the soap with water into a mass, of a proper consistence to be divided into pills, each containing three grains." One or two of these pills may be taken as a laxative, from three to six as a purgative. They do not differ materially from the officinal aloetic pills in their mode of operating, though somewhat more active.

Hooper's pills.—These vary in their composition even more than the preceding, so that aloes appears to be their only constant ingredient. They are directed to be prepared in the following manner by the Philadelphia College of Pharmacy. "Take of aloes 40 parts, sulphate of iron in crystals 20 parts (or dried 11 parts), extract of black hellebore 10 parts, myrrh 10 parts, soap 10 parts, canella in powder 5 parts, ginger in powder 5 parts. Beat them well together into a mass with water, and divide into pills, each containing two and a half grains." These are a tonic, laxative emmenagogue, much employed in domestic practice as a remedy in chlorosis, amenorrhœa, and other depravations of health attended with constipation and disordered digestion. Two or three are taken for a dose every other night at bed-time. Aloes, extract of black hellebore, and sulphate of iron, are their active constituents, the other ingredients being in too small proportion to produce any material effect.

Compound decoction of aloes.—Decoctum aloës compositum, L. Ph.—Prepared by boiling, of aloes, myrrh, and saffron, each, a drachm, liquorice half an ounce, and carbonate of potassa two scruples, with a pint of water to twelve fluidounces, straining, and adding four fluidounces of the compound tincture of cardamom. This decoction is milder as a cathartic than aloes itself, and less liable to produce or aggravate hemorrhoidal affections, while it is rendered more tonic and cordial by the myrrh, saffron, and cardamom, and possesses antacid properties from the presence of the alkaline carbonate. The dose

of it as a laxative is from half a fluidounce to two fluidounces. *Simple decoction* is not an eligible mode of preparing aloes for administration, as it favours the influence of the air upon the bitter extractive, a portion of which becomes insoluble and inert, without any alteration of the remainder; so that the effect of the process is equivalent merely to a diminution of the dose.

Tincture of aloes.—Tinctura aloës, U. S. Ph.—Prepared by macerating aloes and liquorice in diluted alcohol. The tincture of the British Colleges is prepared with a weaker spirit, not much exceeding wine in strength, and is, therefore, less stimulating. The dose is from half a fluidounce to a fluidounce and a half; but the preparation is ineligible unless in low forms of disease requiring stimulation, or in the cases of drunkards.

Tincture of aloes and myrrh.—Tinctura aloës et myrrhæ., U. S. Ph.—*Tinctura aloës composita*, Lond.—This tincture, which is prepared by macerating aloes and saffron in tincture of myrrh, is a modification of the *elixir proprietatis* of Paracelsus. It is used chiefly as a laxative, tonic, and emmenagogue, in chlorosis and other disordered states of health in females, connected with retained, suppressed, or deficient menstruation, and constipated bowels. It may be used also in the costiveness and gastric debility of cold languid habits, in both sexes. The dose is one or two fluidrachms.

Ethereal tincture of aloes.—Tinctura aloës ætherea, E. Ph.—This differs from the preceding tincture only in containing sulphuric ether, which adapts it to the treatment of cases complicated with spasm or irregular nervous action. The dose is the same.

Radcliff's elixir is a compound tincture of aloes, prepared, according to Dr. Paris, by macerating six drachms of aloes, half a drachm of cinnamon, half a drachm of zedoary, a drachm of rhubarb, half a drachm of cochineal, and two fluidounces of syrup of buckthorn, in a pint of proof spirit and five fluidounces of water. The dose as a laxative is from two to four fluidrachms.

Wine of aloes.—Vinum aloës, U. S. Ph. —Prepared by macerating aloes, cardamom, and ginger, in Teneriffe wine. It consists of the same ingredients as the *Vinum aloës Socotorinæ* of the Edinburgh College, but is nearly twice as strong. The London College prepares the wine with aloes and canella, in the proportions in which these substances enter into the *powder of aloes and canella*, or *hiera picra*. The dose as a stomachic laxative is one or two fluidrachms, as a purgative from half a fluidounce to two fluidounces.

Extract of aloes.—Extractum aloës purificatum, L. Ph.—*Extractum aloës hepaticæ*, D. Ph.—This is prepared by forming an infusion or decoction of aloes, straining and defecating the liquor, and evaporating the clear part to a proper consistence. It is a useless preparation; as the portion of aloes insoluble in water is not large, and possesses no injurious properties; while, in the process of evaporation to which the liquid is subjected, a part of the active bitter principle becomes insoluble and inert. The resulting extract, therefore, does not differ from aloes itself in properties, and is not materially stronger. The dose is from five to fifteen grains.

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Geo. B. Wood.

ALOGOTROPHIA. (From αλογος, disproportionate, and τροφη, nutrition.) Unequal or disproportionate nutrition, as when one part receives a greater degree of nourishment than another. According to Chomel it was particularly employed to designate the irregular manner in which the nutrition of bones takes place in rickety persons. I. H.

ALOPECIA. (From αλωπηξ, a fox, this animal, it is said, being subject to a species of itch or mange causing its hair to fall off.) αλωπεκια, Gr.; *Porrigo decalvans*, Lat.; *Mue du poil, Pelade*, Fr.

The term Alopecia is used to imply any unusual falling of the hairs, from the head or other part or parts commonly furnished with them. The affection is noticed by most ancient writers, Asclepiades, Avicenna, Galen, Celsus, Pliny, and others, having treated of it in detail. By these, several varieties or forms of the disease were designated, the appellations of which were given more in reference to the different manner in which the hair fell off, than to the nature or causes of its falling. Thus, when the shedding occurred so as to leave bare patches of no particular form, the affection was termed by Celsus, after

the Greeks, αλωπεκια. But when the patches, instead of being regular, appeared of a lengthened form, commencing on the occiput, and continuing towards the temples and forehead, in a serpentine shape, the affection was termed οφιασις. These constitute the two varieties into which CELSUS divided what he terms *area*. (Lib. VI. Sec. IV.) When the thinning of the hair took place regularly and indiscriminately over the head, the appellation of *fluxus capillorum* was applied to it by the Roman writers. Where the affection is so universal as to leave not a single hair upon the surface of the body, the term *Pelade* has been applied to it by the French writers.

By the modern authorities, the varieties of Alopecia have been generally designated with special reference to the causes from which they have originated; as for example, Alopecia porriginosa, loss of hair attendant upon the cutaneous affection called porrigo; Alopecia syphilitica, resulting from secondary syphilis, etc.

The immediate cause of the falling of the hairs is generally, if not uniformly, a diseased condition of the pilous follicles into which their bulbs are inserted, and through which they derive their nourishment and support. This morbid change is sometimes of an inflammatory nature, with, or without ulceration, and at others an atrophy and destruction of the follicles. The fall of the hair is occasionally sudden, the body having been left bare in the course of a few days; whilst not unfrequently it is so very gradual as to be almost imperceptible. Sometimes the skin, from which the hair has fallen, appears sound, free from redness, or any unnatural alteration; at others it is of a dead whitish hue, and scurfy: sometimes it is scattered with reddish inflamed points; then again with scales, on the removal of which the surface appears of an erythematous redness. In some instances, there is scarcely any perceptible sensation accompanying the affection, whilst in others there is more or less itching, or pungent pricking. The appearance of the hair shed, is sometimes unaltered, sometimes diseased. Under both circumstances, where the falling off is in spots, the surrounding hair will often appear as thick and strong as natural.

We think the subject admits of a convenient general division into—1st, *Idiopathic* Alopecia, wherein the follicles themselves are primarily affected, independently of any specific, local, or general disorder: 2. *Consecutive* Alopecia, the result of secondary causes, such as general debility of the constitution, or a lesion seated in a distant organ: 3. *Symptomatic* Alopecia, arising from some specific disease existing in the capillary tissue itself, such as porrigo, eczema, &c.

Instances of the idiopathic kind are, comparatively speaking, of rare occurrence, comprising for the most part cases arising from the falling or destruction of the hairs produced by depilatory substances, such as quicklime, or from friction, pressure, or the effects of age. When from pressure, though this is often from without, it may proceed from tumours seated beneath the scalp, which tumours being resisted by the cranium, press upwards, and stretch the skin unduly. When from the action of other mechanical pressure, or from chemical depilatories, the follicles become permanently closed after the falling of the hair. A similar obliteration takes place in Alopecia Senilis, or Calvitas, as it is also termed; the progress of which is generally very gradual, affecting commonly the superior and anterior portions of the scalp, so that at length there remains but a semicircle of hair reaching from one temple around the back of the head to the other temple. The age at which it commences is very variable, though usually a little before the arrival of the 40th year. Previous to the falling out of the hairs, the little cavities into which the bulbs or roots are inserted, gradually diminish, the capillary vessels by which the hairs are nourished cease their function, and the hair falling out, the little canals in the cutaneous tissue into which they were inserted, close up and become permanently obliterated.

Women do not become bald from the advance of age, to the same extent as men, their hair usually becoming gray without falling out. It is remarked as a curious fact, illustrative of the influence of the genital system upon the economy, that in eunuchs, where the mutilation was performed at an early age, the beard never grows, but yet they are never subject to baldness.

There is another variety of this affection, which we may class under the head of idiopathic Alopecia, namely, that which has been called *congenital*. We do not mean what most writers upon the subject have included under the acceptation, and which is nothing more than a failure or refusal of the hair to grow at the ordinary period of infancy, that is to say, about the 2d year, when the head, instead of being pretty well covered, appears almost bald. This we regard as more properly either a

symptomatic or sympathetic affection. But we would restrict the appellation of *congenital* to cases wherein from birth to maturity there has been no growth of hair, either upon the head or other parts of the body, examples of which we have met with in two or three individuals of the same family.

Consecutive Alopecia is of very frequent occurrence, during convalescence from violent febrile attacks, or the puerperal state, and from general debility incident to most cachetic diseases. The Romans estimated slaves affected with Alopecia at the lowest prices, doubtless from this last mentioned circumstance.

It is very common, after fevers of considerable violence, especially in protracted cases, such as those usually denominated typhoid, for the hair to fall off either partially or altogether. In this case, the long derangement of the healthy functions of the economy would seem to have caused a suspension of those actions of the cutaneous tissue, necessary for the due nourishment and support of the hair. But the capillary canals and cells do not close up so as to obstruct a new growth. In a male subject, that had been reduced to almost complete baldness by a "putrid" fever, Bichat found the canals of the hair in an entire state, with the young hairs sprouting from the bottom. Similar effects are observed to follow upon other morbid conditions of the system, such as those attending scorbutus, hectic fever, syphilis, habitual head-aches, or the long-continued operation of moral causes producing exalted action of the cerebral circulation. The too frequent evacuation of the seminal fluid is also assigned as a cause of the falling of the hair, unattended by any apparent local lesion.

Symptomatic Alopecia may exist in connexion with porrigo, lichen, pityriasis, exzema, impetigo, &c.; the inflammation and ulceration attending which affections, when on the scalp, may extend to the capillary follicles, and involve them in disease.

One of the most remarkable varieties of Alopecia, is that which Bateman has called Porrigo *decalvans*. It is delineated in his XLth plate, and consists of patches of baldness, more or less circular, and without a hair remaining, whilst immediately around the patches the hair is as thick as natural. The surface of the scalp within these areæ, is smooth, shining, and remarkably white. The bald patches generally enlarge, and sometimes become confluent, producing extensive baldness, which continues for several weeks. Although there are no signs of morbid lesion, still Bateman thinks it probable that there may be an eruption of minute achores about the roots of the hair, which are not permanent, and do not discharge any fluid. Chronic gastritis, or inflammatory dyspepsia, is assigned by Todd as one of the chief causes of porrigo decalvans, as well as of some other forms of Alopecia, whether occurring in adults or children.

Treatment. This, as laid down by various writers, is characterized by great diversity, a circumstance, however, which is plainly attributable to the multiplicity of forms under which the affection appears. It is evident, that in most of the cases of idiopathic Alopecia, especially that most common of all which proceeds from age, the closing up and total obliteration of the canals and follicles from which the hairs proceed, destroy all hopes, and even the possibility of a new growth. Nevertheless, numberless applications under the various forms of oils, ointments, lotions, balms, balsam, etc. etc., are imposed upon the public as infallible preservatives against the falling of the hair, and even capable of reproducing it where it has fallen off. These are purchased with avidity by most of those who become alarmed on perceiving their hair beginning to grow thin. The desire of such to prevent or remedy the effects produced by the inroads of time, make them ready dupes to the artifices of charlatans, and it is often not until after a considerable waste of money, that they become convinced of the delusion under which their fond hopes had placed them.

Consecutive Alopecia, from most of the causes mentioned under our second head, seldom requires any particular treatment, as the hair will generally be gradually restored in due time upon the removal of the causes and restoration of the vigour and healthy actions of the system. It is, however, commonly thought that the reproduction and growth of new hair may be promoted by certain means, such as shaving the scalp, and keeping it well covered with flannel, or other warm material, and if the new growth be sparse, the French practitioners employ fomentations of southernwood, (Artemesia abrotanum,) horehound, (Marrubium album,) centaury; or the aromatic, vinous, and alcoholic preparations of more or less strength; or the oils of lavender, chamomile, juniper, and laurel. A hair-dresser, with whom we have conversed, who has acquired great repute for his supposed skill in arresting the progress of baldness, disapproves very much of shaving the scalp, and

prefers frequent clipping the hair with scissors. Where the skin is dry, wrinkled, and scurfy, the employment of emollient and unctuous applications, as, the mucilaginous decoction or poultice of flaxseed, a strong decoction of the root of althea, the oils of sweet almonds and olives, fresh and pure, with others of a like nature, is also recommended. It will readily be conceived that these and other local applications will be of little utility so long as the primary derangements remain which produced the falling of the hair. If, for example, cerebral excitement is maintained by excessive mental exertion, or there is a frequent discharge of the seminal liquor, both causes must necessarily be removed, the former by relaxation of mind, and the latter by the observance of continence, before any amendment can be expected. So, likewise, where Alopecia exists as a consequence of constitutional affections, such as in the syphilitic and scorbutic varieties, the original diseases must be removed before any local treatment can be of much advantage.

It is recommended by standard authorities, that in every case of alopecia, incident upon diseases demanding particular treatment, on the commencement of the employment of general remedies, the head should be shaved, and the operation repeated frequently afterwards upon the growing out of the new crop. This is supposed to exert a favourable action by causing such a retention, in the enfeebled bulbs, of those nutritious fluids destined for the nourishment of the hair, as will prevent the new growth from falling off, giving also a condition more favourable to its development in thickness and beauty.

A long list of most heterogeneous articles has long been supposed—especially by the vulgar—to be endowed with properties calculated to favour the renewal and growth of the hair after its removal from disease or other causes. Such are, the fat of certain animals, as that of the bear, stag, rabbit, mole, hedgehog, eel, and even the snake; a variety of liniments and lotions containing camphor, turpentine, naphtha, laudanum, tincture of tobacco, tincture of cantharides, distilled water of beeswax, ley; to which may be added burnt cane, the bile of certain animals, ordure of birds, as, for example, the ancient remedy of stercus columbinus, alum, the cimoleon earth and wine, or green vitriol, (the atramentum sutorium of Celsus,) &c. &c. Many of the articles enumerated are more or less disagreeable, and some of them revolting; but with the exception of the tincture of tobacco, which must always be used cautiously, the others are generally harmless.

When Alopecia is the result of some obvious lesion of the skin, it is generally owing to the existence of porrigo, impetigo, lichen, eczema, or to some chronic inflammation seated in a distant organ, most commonly the stomach. It is evident that in the varieties of Acne depending upon particular diseases, the treatment must conform to that of the respective primary affections, the removal of which must necessarily precede the restoration of the hair.

Where an inflammatory condition of the cutaneous tissue or pilous follicles exists, it will be first necessary to subdue the inflammation by means of leeches applied over the scalp, assisted by such emollient local applications as the decoction of bran, or marsh mallows, and the internal employment of purgatives. When, however, the original or primary inflammation is seated in the stomach, the leeches should also be applied to the scrobiculus cordis, and a mild diet adhered to. After the subsidence of the inflammatory action, should there appear a deficiency of vitality, this may be increased by applying to the parts affected some stimulating washes, ointments or liniments, such as decoction of the leaves of the walnut tree, or of some of the aromatic and spirituous applications already mentioned. A formula recommended by Todd for this purpose is as follows:—Ol. macis ʒij—Alcohol. fʒiv—M. The same writer recommends pencilling the surface with nitrate of silver, or rubbing it with olive oil to which as much nitric acid is added as will make a pungent but not an acrid liniment. Where the skin is scurfy or the cuticle hard, shining and impermeable, resembling parchment, washing it frequently with some alkaline or sulphurous solution may be found useful. The following lotion is recommended by Todd for this condition. Liquor. ammoniæ acetatis f℥ij—ammoniæ carbonatis ʒij—alcohol. f℥ss—aq. font. f℥iv—ft. lotio.

Bateman recommends as a liniment the essential oil of mace in the proportion of ʒij to ℥iij or ℥iv of alcohol; or as a substitute for the oil of mace, oil of tar, Petroleum Barbadense, camphor, turpentine, &c. Celsus and after him most modern writers, recommend the daily shaving of the parts affected, which practice is to be persevered in until the hair appears sufficiently strong and thick. Should the ex-

ternal applications and internal means already mentioned not perform a cure, constant shaving may be requisite as an additional means.

We have met with several cases of that symptomatic variety of the affection denominated porrigo decalvans, in children of scrofulous and cachectic habits, where the mesenteric glands have been enlarged or obstructed, and always succeeded in effecting cures by means of ointments and liniments, the basis of which were mercurial preparations, to which local treatment, certain internal means were added, such as the use of Plummer's powder or pills, or very minute doses of the corrosive sublimate, and decoctions of dulcamara and sarsaparilla.

In young persons, the new hair which springs up will be generally found of a much softer texture and lighter colour than the rest, whilst in those beyond the middle age it is mostly gray.

With regard to the relative susceptibility of cure in the several varieties of Alopecia, CELSUS observes, that, "the most obstinate cases are those in which the skin appears thickened, fatty, and entirely smooth:" and some modern observers, of high authority, have remarked, that if the skin be pale or insensible, and it is difficult to produce redness by friction, a cure is hopeless.

The symptomatic form of Alopecia designated *syphilitica* would appear from the observations of TODD and others, to be of rather rare occurrence. This author quotes the authority of M. CULLERIER of the Hôpital des Venériens at Paris, who, in 25 years, was in the way of seeing from 2 to 3000 venereal patients every year, but who states that out of the whole number he never met with more than 3 or 4 cases of *universal* alopecia (pelade), and 50 or 60 of *partial* alopecia. Judging from our own experience, we should think partial alopecia syphilitica by no means unfrequent in America, having often met with it in secondary syphilis involving the cutaneous tissues. We have seen not only the hair of the head very greatly thinned from this cause, but in some cases the eye-brows almost denuded. It would appear to be less rare in the southern portions of Europe, Italy, Spain, &c., than in the more northerly parts. As far as our experience has gone, this variety has always yielded in a short time to the ordinary remedies for secondary syphilis.

G. EMERSON.

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I. H.

ALPINIA. (*Botany.*)

Sex. Syst. Monandria Monogynia.—*Nat Ord.* Scitamineæ.

Gen. Ch. Corolla with the interior border unilabiate. Anther double. Capsule berried, three-celled. Seeds arilled. ROXBURGH.

Much confusion has always existed in the natural order of Scitamineæ as regards the exact limits of the respective genera composing it. The researches of ROSCOE, however, have thrown much light on this intricate subject, though much still remains to be done in the definition of certain of the species. This is remarkably the case with many of those now classed in the genus under consideration, which presents many anomalies. As described by LINNÆUS in his Systema Vegetabilium, it was formed of but one species, the *A. racemosa*, he having referred several other plants, now considered as appertaining to it, to *Amomum* and *Maranta*, with which and *Costus* it is closely allied. At the same time it has been clearly shown by MATON and DRYANDER that but little dependence is to be placed on the arrangement and synonomy of this and many other of the Scitamineæ, as given by that illustrious naturalist. As now recognized by ROXBURGH, LINDLEY, and others, it absorbs *Hellenia* of WILLDENOW and RENEALMIAS (Andrews, Bot. Repos. 360 and 421.), but is by no means natural, as will be hereafter shown. It is founded on the *A. racemosa* (Plumier, *Amer. tab.* 20), with which few of the other species agree in their inflorescence

1. *A. racemosa*, LINN. *A. Jamaicensis*, GAERTNER not of GMELIN. *Amomum pyramidale*, LAMARCK. *A. alpinia*, ROTTBOEL. *Zinziber sylvestre minus.* SLOANE. *Sp. Ch.* Lip trifid. Leaves ovate lanceolate, apex revolute. Capsules striated. LINDLEY. This species, which is a native of the West Indies, is not used in medicine, but on the contrary, according to POUPEE DESPORTES, the seeds are exceedingly poisonous, causing the most violent symptoms, which are, however, said to be relieved by a free use of lemon-juice. (*Fl. Méd. des Antilles.* III. 91.)

2. *A. galanga.* Greater galangal. *Le grand galanga,* Fr.; *Galgant,* Germ.; *Khoolinjan.* Hind. *Sp. Ch.* Leaves sessile, broad lanceolate. Panicle terminal. Lip oblong, unguiculate, bifid. Capsule obovate, smooth. Seeds few. LINDLEY. This plant, which is the *Maranta galanga,* LINN., *Amomum galanga,* LOURIERO, is a native of many parts of southern Asia, and furnishes the true *Galanga major* of the shops. This is a tough woody root, of about an inch or an inch and a half thick, of a brown colour on the outside, and whitish within, having a very thin bark, which is annulated. It has a faint aromatic smell and strong pungent taste, like a mixture of pepper and ginger, but is much less esteemed than the Lesser galangal, which is an article of ten times more value in the estimation of the Hindoo practitioners. It is not known what plant furnishes this latter: as found in the shops, it is in pieces about an inch long and half an inch thick, of a reddish brown colour on the outside, and a pale red within, being knotty and having several circular rings. It is of a firm texture, but is not heavy. It is cut with difficulty. It has an acrid, hot peppery taste, which is very permanent. Both these roots are much employed in dyspepsia, by the native doctors in India, and are also considered as useful in coughs, when given in infusion. They are, however, but seldom or ever used in this country or in Europe, their place being supplied by ginger and warm stimulants of the same nature.

3. *A. cardamomum,* ROXBURGH. Cardomom. *Petit Cardomome,* Fr.; *Kleine Kardamomen,* Germ.; *Gujarati elachi,* Hind. *Sp. Ch.* Scape terminal, compound, flexuose, procumbent. Lip three-lobed, calcarate. LINDLEY. This species is a native of the mountainous part of the coast of Malabar, where it is called *Ailum chedy* by the natives, according to ROXBURGH, *Elattari* according to AINSLIE, and *Ela kandy* according to WHITE. It has a tuberous root furnished with many fleshy fibres. The stems, which are numerous, are perennial, and about six to ten feet high. The leaves are sheathing, entire, lanceolate, and from one to two feet in length. The flowers are in a panicle on scapes, of which several spring from the base of the stem, and rest on the ground. They are succeeded by ovate somewhat three-sided capsules, about the size of a small nutmeg, having three cells and three valves. The seeds are many and angular.

There can be no doubt that this species furnishes the lesser Cardamoms of commerce, though much confusion and uncertainty have existed not only on this point, but also as to the genus to which it properly belongs. LINNÆUS evidently confounded two very distinct plants under the name of *Amomum cardamomum,* the plant in question and the true *A. cardamomum* which is also the *Cardamomum minus* of RUMPHIUS, and furnishes seeds which are used as substitutes for the true cardamoms. This, in all probability, is the plant spoken of by THUNBERG under the name of *Amomum cardamomum Javanicum* (Flora Japonica). WILLDENOW separated them, retaining for the first the name of *Amomum repens,* which had previously been bestowed on it by SONNERAT (Ind. occident. II. 240). From a detailed description of the plant and its mode of culture, by Mr. WHITE, a surgeon on the India station, Dr. MATON was of opinion that it did not belong to *Amomum,* and therefore established a new genus for its reception under the name of *Elettaria,* from its native appellation. Sir JAMES EDWARD SMITH, however, proposed that this should be changed to *Matonia,* which suggestion being adopted by ROSCOE in his great work on the Scitamineæ, this name was followed by the authors of the London and United States Pharmacopœias. As, however, ROXBURGH, LINDLEY, and many other eminent botanists, consider it as belonging to *Alpinia,* and more especially as this is the name by which it is recognized in the United States Dispensatory, we have included it under that head, though we fully agree with Dr. MATON that it cannot in strictness belong to that genus.

This species is extensively cultivated in Malabar, in the following manner. Previous to the rainy season in June, a spot on the shady side of a well-wooded mountain is selected, on which is a large tree, around which all the shrubs and weeds are carefully removed, when the tree is cut down. From the concussion produced, the earth in the vicinity is loosened, and in about a month's time the young cardamom plants make their appearance. These attain maturity about the fourth year, when they are from six to ten feet high; at this time the radical inflorescence appears, succeeded by the fruit, which is ripe in November, and requires no other preparation than drying in the sun. The plants bear till their seventh year, when they are cut down, and the young shoots which then arise, cultivated in the same manner.

Besides their uses in medicine, cardamoms are universally employed in the East

as a condiment, and also held in sacred estimation among the Hindoos, for sacrificial purposes. The East India Company derive a very large revenue from this source, it being said to amount to 25 or 30,000 rupees per annum. (See *Cardamom.*)

4. *A. cardamomum medium. Sp. Ch.* Leaves lanceolate, villous beneath. Spikes radical, lax. Lip ovate-lanceolate. Capsules pedicelled, ovate-oblong, nine-winged. ROXBURGH. This species, which is also a native of India, is found in elevated situations. It flowers about the commencement of the rainy season, and ripens its fruit in September. Dr. ROXBURGH is of opinion, from the form of the capsule, which resembles that of GŒRTNER's *Zinziber ensal*, and from the acrid, aromatic taste of the seeds, that this is the plant which produces the *Cardamomum medium* of the shops. It should, however, be mentioned that MATON quotes this species of GŒRTNER as a synonyme of the *A. cardamomum.*

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ALTERATIVES. (From *alterare,* to change.) This term is not employed in medicine to designate a class of remedies, but rather a mode of operation, common to many remedies. Medicines of almost every class, of the materia medica, possessing the most different and diversified properties, may be employed as alteratives. All medicines in curing disease may be considered as alteratives, but most generally they occasion some evacuation or marked disturbing action in the functions of some organs. When administered in such manner, in doses so small that no immediate perceptible operation ensues, but a gradual improvement follows, they are then said to act as alteratives.

The employment of medicines as alteratives, is a practice of modern times. Much has been said and written on their mode of operation in this character, but very little, it must be acknowledged, is clear or positive, is such as to lead to any certain principles explanatory of their action, or to the establishment of general rules for their practical application. The therapeutics of alteratives remains to be established: it is a task yet incomplete.

As it is of first importance that the therapeutic principles of medicinal action should be determined, as affording the best guide to the appropriate administration of remedial agents, a few suggestions on this subject, it is believed, will not be accounted inapposite or regarded as presumptuous. Though they may not be absolutely correct, yet, by inviting to examination and to reflection, they may prove serviceable by directing the attention of others to this investigation.

The phenomena of vital activity are called into and maintained in existence, and are subjected to numerous modifications, by the influence of exterior agents. Physiological excitants, pathological or morbific causes, and medicinal or therapeutic substances, composing those agents, are then all endowed with active forces by virtue of which they possess the power of acting on living beings. Medicines do not then differ from the other agents that influence the animal economy, except in the intensity of their actions or the specific phenomena they excite in particular organs or the whole organism.

The action of medicines is two-fold. 1st, the local action excited in the living tissue or organ to which they are applied; and 2d, their specific action on some particular organ whose functions they more or less modify. This last depends on their absorption, their introduction into the economy, and direct application through the circulation to the tissues they especially influence. This is seen in Sulphates of Quinia and Morphia applied endermically. They irritate and inflame the skin, as any common, even a mechanical irritant, would do; but being absorbed, the one gives diffused tonic excitement to the whole capillary system—and the other affects the brain. Precisely the same effects result on the internal administration of medicines, with this additional circumstance, that the stomach being the centre, as it were, of the sympathies, the local action

awakened in that organ often excites sympathetic action interfering with and sometimes destroying the specific action of the remedy. This is manifested in digitalis. If the stomach be highly irritable, the local excitement of the digitalis on the gastric mucous membrane is extended by sympathy to the heart, and counteracts its specific sedative action over that organ.

The grade of action, both local and general, of specific medicines varies, depending on the dose in which they are administered. In large doses they pass beyond the boundary of healthy or physiological action. They are perturbating in operation, carrying disturbance into the functions of the organs and causing disorder in their structure: their action is then pathological, and may even proceed to a degree proving fatal by the energy of their active force. The injudicious administration of those powerful agents, has justified the ancient adage—*plus a medico, quam a morbo periculum.* When employed in moderate doses, the diminished energy of their power brings them within the limit of physiological or healthy action: the functions are not deranged, or the structure threatened with disorganization by the violence of their operation. No immediate appreciable action is to be discovered—they act slowly but safely—the local action never destroys their specific effects—no sympathetic commotion endangers the order of their operation—everything is conducted by healthy, not morbid, processes—disordered functions gradually assume their natural condition, and the structural derangements, by the gentle solicitations of healthy therapeutic excitements, are dissipated by the improved order brought about in the nutritive or formative actions. This last category embraces the mode of action of *alteratives.* They are consequently no more than medicines exhibited in doses that restrict their active forces within the physiological or healthy grade of action—that which is natural to the tissues. The alteratives often do no more than carry this physiological action to its highest pitch; they develop vitality in its most perfect condition, in several tissues or organs—sometimes throughout the economy, and in this manner destroy local functional or organic derangement.

The minimum dose in which the active force of medicines can produce effects, modify the phenomena of the organism, and act as alteratives, has not been ascertained by very positive observations. Many of them—those endowed with great activity, are capable, when gradually introduced into the economy, and perseveringly employed, of accomplishing decided modifications, often of great efficacy in the cure of chronic diseases, exhibited in very small doses. We have evidences of the fact in the unquestioned beneficial influence of many mineral waters, in which the medicinal substances exist in exceedingly minute quantities. Arsenic, corrosive sublimate, and iodine, furnish also instances in which very minute quantities will occasion even disturbing actions almost pathological in degree; and from which medicines salutary results may be obtained by incredibly small doses. I have repeatedly known the syrup of Cuisinier (the original of Swaim's Panacea), containing from one to two grains of corrosive sublimate to the quart, and administered in ℥ss doses once or twice daily, to develop the mercurial action in the economy. The salts of morphia, strychnine, and similar substances, will occasion appreciable phenomena in doses of the $\frac{1}{20}$ and $\frac{1}{30}$ of a grain.

Could full credit be given to the Homœopathists, the millionth and billionth of a grain of medicine may exercise a potent influence. But, from actual experience in this mode of treating cases, (acting on the precept of Paul, "prove all things,") I am disposed to regard their observations, to a certain extent, as visionary. Daily changes and fluctuating phenomena in the functions of the economy, may be observed by those who will pay attention to them, while in the full enjoyment of health. To a still greater extent are they witnessed in disease, and more clearly are their effects, when proceeding from the recuperative operations of the organism, seized on and appreciated by those who are accustomed to adopt in the treatment of disease, the expectant or Hippocratic method. Now, these, the natural phenomena, the preservative and curative reactions of organs for their own protection and recovery, are, I believe, mistaken for the effects of the excessively minute dose that may have been administered. As many of the Homœopathic remedies are absolutely inert, this conclusion appears the more probable, and the testimony as to the fact of the activity of medicines being felt in those very minute doses, must remain at least questionable, if it be not unqualifiedly rejected.

There are, however, some facts that demonstrate great activity of power combined with an exceeding small quantity of matter. In the experiments of Fontana on the poison of the viper, he ascertained that it destroyed life in animals of small size, as sparrows, and pigeons, in the

quantity of $\frac{1}{1000}$ to $\frac{1}{250}$ part of a grain. Spallanzanni found that a drop of the semen of the frog, mixed with a pint of water, imparted to it fecundating properties, and that thousands of the eggs in the spawn could be fecundated with it. The virus of variola and vaccine, when a drop of it is diluted with a hundredth of water, and a drop of that placed on a small point of the skin freed from the cuticle, will bring the whole economy under its influence—will modify in a manner wholly unknown the entire organism, so as to render it insusceptible of experiencing a second time the effects of small-pox contagion. Miasmatic and contagious effluvia, though so very minute in quantity as to escape the perception of our senses and to defy all the means of our research for their detection, poison the economy to such an extent, as often to extinguish the vital properties and prostrate the functions essential to vitality, too rapidly to be retrieved by the resources of art. These are strong analogies, from which it would be fair to infer the possibility of medicinal effects and therapeutic operations from doses of active medicines, far less than it is generally customary to administer.

Another consideration has a bearing on this point. All the phenomena of natural objects may be referred to two classes—statical, or those belonging to the structure, the composition, the material properties; and dynamical, or those proceeding from the forces causing movements and action in the material elements of objects. Both exist in organized beings, but the last in this class of beings has attracted very little attention, are nearly unknown, and consequently, it is impossible to affirm any propositions as to the manner in which they may be affected, or what is or is not capable of influencing them, and thus modifying the actions of the economy or particular organs.

The minimum doses of active agents capable of producing, as alteratives, positive effects on the animal organism, cannot be considered as yet established in an absolute manner.

The alterative medication is chiefly applicable to the treatment of chronic diseases. In some instances it may be adopted even in acute affections. Cholera infantum, it is well known, is often arrested by calomel in doses of $\frac{1}{8}$ to $\frac{1}{20}$ of a grain administered every hour. No appreciable operation is accomplished, yet the vomiting and purging will be allayed. Follicular enteritis, known more familiarly under the names of typhoid fever, typhoid remittent and bilious fever, I find to be infinitely more manageable when treated with occasionally local depletion, as it may be indicated by local symptoms, the expectant method, and alterative doses, than by the perturbating and evacuant plan. Under this course I rarely see it fatal.

The diseases most usually combated by alteratives are:

The chronic affections of the digestive organs; the stomach, liver, and alimentary canal:

The chronic diseases of the lymphatic apparatus—scrofula, tubercles, &c.:

The chronic affections of the skin:

The sequelæ of syphilitic affections with impaired constitution:

The ulcerative affections, the chronic inflammations, the general deterioration of the health from the injudicious administration of mercury:

The incipient stages of phthisis, chronic pneumonitis, hepatization of the lungs:

Chronic rheumatism:

Most of the affections of the nervous organs and functions.

In the above diseases, the alterative medication, conjoined with the more efficient alterative action obtained by exercise, salubrious atmosphere, and appropriate diet, is to be preferred and mainly relied on.

The medicines most usually resorted to for the purpose of accomplishing the alterative medication are:

The preparations of mercury; as corrosive sublimate in the dose of $\frac{1}{30}$ and $\frac{1}{20}$ of a grain. Its effects in syphiloid and cutaneous ulcerations; in syphilitic rheumatism; are enhanced by its conjunction with sarsaparilla and occasionally some of the narcotics, as cicuta and opium in minute doses. Calomel in dose of $\frac{1}{16}$ and $\frac{1}{8}$ of a grain; the mass. hydrargyra or blue pill in doses of grss to grii, are the mercurial preparations chiefly preferred.

Iodine, in scrofulous affections, offers unquestionable advantages. The solution of Lugol is to be preferred, and the doses from iii to v gtt.

The Solution of Iodide of Iron I have introduced into practice in this city, where it has acquired considerable celebrity. It acts as a mild tonic, an emmenagogue, and brings on a more healthy hematosis.

Sarsaparilla, as the basis of numerous syrups and tisans, is a highly esteemed alterative.

The vegetable and mineral tonics in doses so small as to avoid any danger of irritating the stomach, often present valuable resources as alteratives, modifying the general nutrition and hematosis.

Various mineral waters, diet, exercises of various kind, food appropriated to the state of the organs and economy, all, by judicious management, can be made to produce alterative effects of a lasting and deeply penetrating character.

S. JACKSON.

ALTHÆA. (*Botany.*)

Sex. Syst. Monodelphia Polyandria. *Nat. Ord.* Malvaceæ.

Gen. Ch. Polygynous. *Calyx* double, external with nine sepals. *Capsules* numerous, circularly arranged, one-seeded. HOOKER.

A. officinalis. Marsh Mallow. *Guimauve*, Fr.; *Eibisch*, Germ.——*Sp. Ch.* Leaves soft, tomentose on both sides, cordate and ovate, dentate, entire or three-lobed; peduncles axillary, many-flowered, much shorter than the leaves. BECK. This plant, which is indigenous to the southern part of Europe, and has been introduced into this country, is generally found in wet situations. In Europe it is extensively cultivated for its roots, which are much employed for a variety of medicinal purposes. These, as found in the shops, are in pieces of three or four inches in length, about the thickness of the finger, of a white colour externally, owing to the removal of the grayish-yellow epidermis. They possess scarcely if any smell, and have a vapid mucilaginous taste. They have often been analyzed with nearly similar results, namely, a large proportion of mucilage, fecula, inuline, &c. M. BACON (*Journ. de Pharm.* XIII. 19.) discovered what he thought was a new principle in them, on which he bestowed the name of *Altheine;* subsequent researches, however, have shown that it was identical with asparagine. The Marsh Mallow is very generally employed in Europe as a demulcent or emollient; but in this country its use is very limited, its place being supplied by other articles of equal efficacy which are more readily procurable. It would be superfluous to advert to the various preparations of this article and their particular applications; it is sufficient to state, that, externally it is employed in fomentations, baths and cataplasms, and internally, in infusion, in syrup and in a conserve which enjoys a high reputation as a demulcent in irritations and inflammations of the respiratory organs. The powder is also used to give consistence to many pharmaceutical preparations. As almost all the Malvaceæ possess the same mucilaginous properties, several of them are advantageously substituted for the Marsh mallow in practice; some of them, in fact, present much higher claims to notice; thus, the *Hibiscus esculentus* or Okra abounds in a bland mucilage, which might be advantageously employed as an emollient in many of the phlegmasiæ.

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ALUM. (From *alumen*, Latin for *alum.*) *Alun*, Fr., Dan., Swed.; *Alaun*, Germ.; *Allume*, Ital.; *Alumbre*, Span.

Alum is a double salt, consisting of the sulphate of alumina, united with the sulphate either of potassa or ammonia. When the second base is potassa, the salt is called *potassa-alum*, or simply, *alum;* but when this base is ammonia, it is called *ammoniacal alum.* The officinal alum, however, is the potassa-alum; and this variety of the salt is to be understood, whenever, in the following remarks, the simple term is employed.

Discovery and Preparation. The discovery of alum dates from a very early period, and is attributed by BECKMAN to the Asiatics. For a long time, it was brought to Europe from the East. In the fifteenth century, several manufactories of it were established in Italy; and in the following century, others were set up in Germany, Spain, England, and France.

Alum is sometimes made by the direct combination of its constituents; but more usually from certain minerals, which contain either the salt ready formed, or its principal ingredients. When prepared by direct combination, clays are selected as free as possible from iron and carbonate of lime, and dissolved in dilute sulphuric acid. The sulphate of alumina thus formed is then crystallized into alum by the addition of the requisite quantity of sulphate of potassa. This process is sometimes pursued in France. The minerals principally employed in the manufacture of alum, are aluminous schists and alum-stone. The schists are roasted, during which operation, the sulphur of the sulphuret of iron which they contain is oxidized, and passes to the state of sulphuric acid. This then combines with the alumina and potassa, bases which, in conjunction with the peroxide of iron, magnesia, and silica, form

the incombustible part of the mineral. The roasted mass is exposed to the air for some time, after which it is lixiviated. The alum formed dissolves, but it is rendered impure by the presence of peroxide of iron, from which it must be purified by repeated crystallizations. The alum-stone is principally worked at Tolfa in Italy. This mineral contains all the constituents of alum, but with a large excess of alumina in a hydrated state. By a gentle calcination, the water of the hydrate of alumina is driven off, whereby the excess of this earth becomes insoluble. The calcined mass is exposed to the air for several months, after which it is lixiviated. The solution obtained, by proper concentration, yields alum, exceedingly pure, known in commerce by the name of *Roman alum.* In Great Britain, alum is prepared from a species of aluminous schist, by a process similar to the one first described. In the United States, it is manufactured to a sufficient extent to supply the domestic demand. The process usually followed in this country, is by the direct combination of the ingredients. In Maryland, it is manufactured from an ore found at Cape Sable, consisting of lignite, clay, sulphuret of iron, and sand. Upon treating the different alum minerals with a view to their conversion into alum, the potassa present in them is usually insufficient to convert the sulphate of alumina into the double salt, and hence the necessity, in almost all instances, of adding the sulphate or some other salt of potassa, in order to crystallize the alum.

Ammoniacal alum, or the sulphate of alumina and ammonia, is sometimes manufactured in France, where it is formed by adding putrid urine to a solution of sulphate of alumina. This variety of alum resembles the potassa-alum so exactly, that it is impossible, by mere inspection, to distinguish the two salts from one another. Their taste, mode of crystallization, and action on vegetable colours, are perfectly similar. The ammoniacal alum, however, may be distinguished by the circumstances that when calcined, it is reduced to the state of pure alumina, and when rubbed up with a fixed alkali and a little water, the odour of ammonia is perceived.

Besides *ammoniacal alum*, there are several other varieties of this salt, known to the chemist, but not employed in medicine or the arts. These are the *soda-alum*, *lithia-alum*, &c. In all these varieties, the peculiarity consists in the substitution of some other base for the potassa, the alumina never being replaced by any other substance, as it is essential to the constitution of the salt.

Properties of Alum. Alum is a white, slightly efflorescent salt, crystallizing in octohedrons and possessing a sweetish, astringent taste, and acid reaction. It dissolves in between 14 and 15 times its weight of cold water, and in three-fourths of its weight of boiling water. When heated a little above the boiling point, it undergoes the aqueous fusion, and by a continuance of the heat, it loses its water, and becomes a dry, white, opaque mass, called *dried* or *burnt alum.* Exposed to a violent heat, it gives off oxygen, together with sulphurous and sulphuric acids; and the residue consists of alumina, and sulphate of potassa. It is decomposed by a number of substances, with which it is, consequently, incompatible in prescriptions. Among these are the salts of lime and of magnesia, the carbonates of potassa, soda, and ammonia, the muriate of ammonia, the tartrate of potassa, and the greater number of metallic salts. It may be associated, however, with the corrosive chloride of mercury and the metallic sulphates without decomposition.

Composition. Alum was supposed to be simply sulphate of alumina, until it was proved by Descroizilles, Vauquelin, and Chaptal, to contain the sulphate of a second base, which is either potassa or ammonia. The exact composition of alum is still a matter of doubt. When its second base is potassa, it probably consists of three equivalents of sulphate of alumina 174, one of sulphate of potassa 88, and twenty-four of water $216 = 478$. In the other kinds of alum, the sulphate of potassa is replaced by one equivalent of the sulphate of the second base, whatever this may be.

Several sorts of alum are distinguished in commerce, according to their source; as Roche alum, English alum, alum of the Levant, Roman alum, &c. *Roche alum* is esteemed a pure kind, and is said to be so called from Roccha, a town in Syria, whence it is stated to have originally come. This term, however, is often used in a different sense, being applied to alum which has been crystallized in mass at the time of its manufacture. *Roman alum*, characterized by its being slightly covered with a pink powder, is the most esteemed in Europe, on account of its freedom from oxide of iron; while the other commercial kinds contain from five to seven parts in a thousand of this oxide, and are, therefore, less fit to be employed in the processes of dyeing. Iron may be detected by adding to the solution of the alum, a few drops

of ferrocyanate of potassa, which will cause a greenish-blue colour. According to Berzelius, alum may be freed from iron, either by dissolving the salt in the smallest possible quantity of boiling water, and then stirring the solution as it cools, or by repeated solutions and crystallizations.

Therapeutical Applications. When alum is applied to a highly vascular tissue, its first effect is to expel the blood from the vessels, and to diminish the redness of the part; but by its long application, the condition first produced disappears, and is succeeded by a true inflammation. When taken into the stomach, it appears capable, either by being absorbed, or by producing a sympathetic action in remote parts, of restraining the secretions in certain conditions of the system. For these reasons, alum is classed as an astringent, and is considered as one of the most powerful in the Materia Medica.

When alum is given in doses, incautiously increased, it produces pain in the stomach, nausea, vomiting, and finally colic and diarrhœa. When its use is long continued in small doses, it frequently induces obstinate constipation. In persons with narrow chests, and irritable bronchiæ, the administration of alum is apt to produce a dry, short cough, showing that the remedy has the property, under peculiar circumstances, of being directed in its action to the pulmonary organs. According to Orfila, alum, given to man in very large doses (as an ounce or two), would not prove poisonous, because it is probable that it would be promptly expelled by vomiting. He is led to this opinion from his experiments on dogs, which experienced no other inconvenience from large doses of alum than vomiting and purging, and recovered in one or two hours. When, however, the œsophagus was tied and vomiting prevented, the animals perished in a few hours from inflammation of the stomach and bowels, and the irritation thence propagated to the nervous system.

Alum is used as a remedy in two principal ways,—*internally*, to act on the general system, and *locally*, to affect particular parts. Its therapeutic applications will, therefore, be most conveniently arranged under these two heads.

1. *Internal Employment.* At one time, alum was alleged to possess febrifuge properties, rivalling those enjoyed by the Peruvian bark; but this supposition has been long since disproved. The classes of disease, in which it is most usually employed as an internal remedy, are hemorrhages and inordinate secretions, when not attended with obvious inflammatory action. The hemorrhages to which it is supposed to be particularly applicable as a remedy, are those for the cure of which depletants are either inadmissible, or have been pushed as far as the state of the system would seem to warrant. Accordingly, it has been recommended by practitioners in certain conditions of hemoptysis and hematemesis. In memorrhagia, occurring at the time of the decline of the menses, Dr. Dewees has often found alum-whey useful. In chronic diarrhœa, it has sometimes been employed with advantage, especially when conjoined with opium, which serves to correct its irritant, without interfering with its astringent property. It has also been used with benefit in some cases of diabetes, and in incontinence of urine, when depending on debility of the sphincter of the bladder.

In the peculiar disease called *Colica Pictonum*, dependent on the poison of lead, the concurrent testimony of a number of practitioners goes to show the decided efficacy of alum. In this disease, it may be supposed to act, in part, on chemical principles, by converting the poison into the insoluble sulphate of lead. The introduction of this practice is attributed to Grashius, who published a Dissertation on Colica Pictonum at Amsterdam in 1752; and the same treatment was subsequently highly recommended by Dr. Thomas Percival, in his *Medical Essays.* The practice is at present pursued by a number of physicians of the hospitals of Paris, and with satisfactory success. The alum, in these cases, may be given, mixed with sugar, spermaceti, or gum arabic, or made into a julep with the latter substance.

2. *Local Employment.* Alum is used, locally, in certain inflammations of a peculiar character, which attack the mouth, throat, and air-passages, and may be considered as acting, not only by its astringent power, but by its escharotic and stimulant properties; whereby it substitutes a new action in place of the one in which the diseased inflammation consists. In elongation of the uvula, and enlargement of the tonsils, as well as in the advanced stages of common inflammatory sore-throat after sufficient depletion, it is often useful in the form of a gargle; in which cases it is beneficial chiefly by acting as an astringent. In aphthæ of the mouth and throat, it is one of the best remedies that can be employed. In those anginose affections, attended with peculiar, membranous exudation, giving the deceptive appearance of ulcerated surfaces,—the *diphtheritis* of M. Bretonneau,—the topical application of alum has

been highly recommended by this practitioner; and his report of its efficacy has been amply confirmed by other French writers. When the affection occurs in adults, a solution of the salt, more or less strong, with the addition of vinegar and honey, is the proper form for using the remedy; but in the cases of children, it is necessary to proceed by the method of *insufflation*. For this purpose, a drachm of finely powdered alum may be placed in one end of a tube, and then blown, by means of the breath, into the throat of the child. The most favourable time for effecting the insufflation is the moment when the child, in the act of crying, draws a long breath; as, when performed at that moment, the particles of the alum are sure to be drawn into the trachea itself. M. TROUSSEAU, who describes this operation in the "Dictionnaire de Médecine," and bears decided testimony to its efficacy, recommends that it should be repeated five, six, or eight times a day. Each insufflation is followed by efforts to vomit, and an abundant flow of the saliva, both of which effects subside in the space of a quarter of an hour. M. TROUSSEAU adds, that where the diphtheritis has not extended to the interior of the larynx, it rarely fails to yield in a few days to the effects of this treatment.

Alum is sometimes employed with benefit in the inflammation of the vulva attended with membranous exudation, which occasionally attacks women and very young girls. A solution of the salt is beneficial also as a lotion in pruritus vulvæ, and as an injection in some cases of memorrhagia, and in leucorrhœa, when the discharge is not attended with heat, or active inflammation. In uterine hemorrhage also, alum has been deemed a good topical application, either applied in saturated solution by means of a sponge inserted into the vagina, or in the form of powder dusted on a tampon. This salt, likewise, is employed as an ingredient in collyria, for various diseases and states of the eye; but these uses can be detailed with greater advantage under the head of the diseases of that organ. It is useful occasionally in excessive salivation, and, according to M. BENNATI, in certain cases of aphonia.

Alum is frequently used by the surgeon in solution as a stimulant astringent to indolent and flabby ulcers; and in powder, either with or without calcination, as a gentle escharotic to such ulcers, and to fungous granulations and excrescences. When used in substance, the part is thickly sprinkled over with the salt, and, if an ulcer, covered with compresses of lint. Certain moist fungous vegetations, which occur on the glans penis or prepuce, or at the verge of the anus, may, in many cases, be caused to shrivel and disappear by being powdered over with calcined alum.

Alum is contra-indicated in diarrhœas, accompanied with pain or inflammation, as also in irritable conditions of the stomach. In hemoptysis, it is inadmissible, unless after the signs of pulmonary irritation have entirely disappeared; for otherwise, it would be likely to stimulate the bronchial tubes too violently and thus produce dangerous results.

The dose of alum varies with the object in view in prescribing it, from five grains to two scruples. The average dose is from 6 to 8 grains, repeated several times a day. In colica pictonum, Dr. PERCIVAL recommends 15 grains to be given every third, fourth, or fifth hour; and in the same disease, M. KAPELER, physician to the hospital Saint-Antoine at Paris, has given, for many successive days, from half a drachm to three drachms daily, in mucilage of gum arabic. In urgent cases of hemorrhage, 20 grains have been recommended at a dose, to be repeated every hour or two until the bleeding abates. Large doses are apt to produce pain, nausea, and vomiting, effects in a measure obviated by conjoining with it opium or an aromatic. For external use, a cold saturated solution is generally preferred. When prescribed in collyria, it is proper to begin with very small quantities of the salt, and afterwards to increase it, if its effects should render this expedient.

Pharmaceutical Preparations. Alum is variously combined and prepared for medical use. When prescribed in colica pictonum, it is sometimes advantageously associated with opium. Two parts of alum, mixed with one of dragon's blood, formed the *anti-hemorrhagic pills* of HELVETIUS. *Alum-whey* is made by boiling two drachms of alum in a pint of milk, and straining the decoction, of which two fluidrachms are a dose. The officinal preparations of alum contained in the United States and British Pharmacopœias are the following:—

1. *Alumen Exsiccatum—Dried alum.* Commonly called *calcined alum*, or *burnt alum*. This is a white powder, made by melting any quantity of alum in an earthen or iron vessel, and continuing the heat, until the water of crystallization, amounting to nearly half its weight, has been dissipated, and the salt is rendered dry. The

dry matter is then reduced to powder. In making this preparation, the capacity of the vessel should be at least three times the bulk of the alum, to afford space for the calcined product, which swells up remarkably into a light, white, opaque, porous mass, of a hemispherical form, having some resemblance to a mushroom. Alum, by being thus dried, is so far altered in its properties, as to take a long time for solution; a circumstance which has led some chemists erroneously to assert that it is rendered partially insoluble by calcination. Dried alum has sometimes been given internally, but its appropriate use is as an escharotic for the use of the surgeons.

2. *Cataplasma Aluminis—Alum cataplasm. Alum curd.* This is peculiar to the Dublin Pharmacopœia, in which it is directed to be made by shaking the whites of two eggs with a drachm of alum, so as to form a coagulum. It is sometimes prepared by stirring the white of eggs briskly in a saucer with a lump of alum, until coagulation is produced. This preparation is used, inclosed between folds of cambric, in ecchymosis of the eye, and particularly in purulent ophthalmia. Alum curd, when mixed with the tincture of camphor (camphorated spirits), forms a useful liniment in chilblains, and for fortifying the skin against the effects of frost.

3. *Liquor Aluminis Compositus—Compound solution of alum.* This was formerly called *Bates's alum water*, and is made by dissolving two drachms, each, of alum and of sulphate of zinc in a pint of boiling water, and filtering the solution through paper. It is a powerful astringent solution, employed for cleansing foul ulcers, and as an injection in gleet and leucorrhœa. When used as a collyrium, it requires to be very much diluted with water. This solution is officinal only with the London College.

4. *Pulvis Aluminis Compositus—Compound powder of alum.* This powder, which is directed only in the Edinburgh Pharmacopœia, is formed by rubbing together into fine powder, four parts of alum and one of kino. It is the *Pulvis Stypticus* of former Pharmacopœias, and is an improvement on the anti-hemorrhagic pills of Helvetius. The substances, of which it is composed, react chemically on each other, but it is not probable that its medicinal effects are thereby impaired. It is used in menorrhagia and chronic diarrhœa, and externally, as a styptic, to repress hemorrhage.

Uses in the Arts. Alum is employed by skin-dressers, by tallow-chandlers to render the tallow more firm, by paper-makers to prevent the ink from sinking into paper intended for writing, and by manufacturers of Prussian blue; but the principal consumption of it is caused by the various processes of dyeing.

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Franklin Bache.

ALUMINA. (From *alumen*, Latin for alum.) A peculiar earth, very abundant as a component part of the globe, present in clays to which it gives their characteristic properties, and an essential base in the constitution of alum. It sometimes occurs pure and crystallized under the name of *corundum;* and, at other times, transparent also, when it forms the precious gems called sapphire and oriental ruby. Associated with potassa and silica, it exists in feldspar and mica, minerals which ordinarily constitute granite and gneiss; and in various states of combination, it is present in a great number of other minerals.

Alumina may be obtained pure from ordinary alum, after being purified from iron, by dissolving the salt in four or five times its weight of boiling water, and then adding to the solution a slight excess of carbonate of potassa. A bulky hydrate of alumina will be thrown down, which, after being well washed with hot water, still retains a small portion of the alkali. To remove this, it is necessary to dissolve the precipitate in dilute muriatic acid, and to throw it down anew by means of pure ammonia or its carbonate. The new precipitate, after being well washed, and exposed to a white heat, is pure alumina. When *ammoniacal* alum can be procured, an easier process is merely to expose this

salt to a strong heat in a platinum crucible, until it ceases to lose weight. By this treatment, the sulphuric acid and ammonia are wholly expelled, and nothing remains but the pure earth.

Properties. Alumina is a white, tasteless, inodorous powder, soft to the touch, adherent to the tongue, and very refractory in the fire. By the action of heat in ordinary furnaces, it contracts and hardens without melting; but when exposed to the intense heat produced by the compound blow-pipe of Dr. Hare, it may be fused into a limpid globule. Its specific gravity is about 2. Though insoluble in water, it is capable of forming a ductile mass with that liquid, a property which renders it proper for the fabrication of all kinds of earthenware, in which, from the commonest pottery to the most costly porcelain, it is always present as an essential ingredient, associated with a portion of silica.

Alumina is soluble in solutions of caustic potassa and soda, but scarcely so in ammonia. It unites with various acids, and forms salts characterized by a sweetish, astringent taste, and by being generally deliquescent and abundantly soluble in water. When treated with potassa, soda, or ammonia, they are decomposed, yielding a precipitate of alumina, soluble in an excess of the two former. None of the salts of alumina are used in medicine except alum, which is described under a separate head. (See *Alum.*)

According to Berzelius, alumina may be distinguished from all other substances by its solubility in caustic potassa, by its property of yielding alum with sulphuric acid and potassa, and by the character of becoming of a beautiful blue colour without fusion, upon being moistened with nitrate of cobalt and exposed to a strong heat.

Composition. Alumina is found, on analysis, to be a metallic oxide, consisting of one equivalent of a peculiar metal, called aluminium, weighing 10, and one equivalent of oxygen $8 = 18$. According to Berzelius, however, whose analysis differs from the above both in the ratio of the constituents, and in their presumed mode of atomic combination, the earth consists of two equivalents of aluminium 27.4 and three of oxygen $24 = 51.4$. *Aluminium* is in the form of a grayish powder, which, examined in the sun, is found to consist of minute scales possessing the colour and lustre of tin. When heated to redness, it burns vividly, combines with oxygen, and is converted into alumina. In oxygen it burns with insupportable brightness. This metal, though partially obtained by Sir H. Davy, and Berzelius and Œrsted, was first completely isolated, and its metallic nature demonstrated, by Wöhler, in 1828.

Therapeutical Application. It is only latterly that alumina has been employed by a few practitioners as a medicine. Judging from the slender experience as yet had of its use, it may be considered to act as an absorbent, and to be particularly applicable to the treatment of diarrhœa and dysentery. Dr. Ficinus has used it in some obstinate cases of these diseases, and with encouraging success. For the cases of infants, he considers it superior to chalk or the carbonate of magnesia. The form of alumina which he employed was the precipitate, obtained from alum by the carbonate of potassa and afterwards dried; and the dose in which he gave it was 8 or 10 grains, rubbed up with a little sugar or gum arabic. Occasionally he found advantage from combining it with opium, camphor, or aromatics.

Franklin Bache.

ALUSIA. (From αλυσις, aberration.) Illusion, Hallucination. Dr. Good has bestowed this epithet upon a genus of diseases which he thus characterizes. "The judgment perverted or overpowered by the force of the imagination; the spirits permanently elevated or depressed; the feelings of the mind depicted in the countenance." This genus comprises two species, *Alusia elatio*, or sentimentalism, and *A. hypochondriasis*, low spirits: it is the former only which will be considered here. The latter will form the subject of the article *Hypochondriasis.* Dr. Good defines the former species as follows. "Romantic ideas of real life; ardent and exalted fancy; pleasurable feelings; frequent pulse; great activity; eye keen and lighted up; countenance confident and animated." This species embraces the following varieties:

α Heroica.	Chivalry. Romantic gallantry.
β Facetosa.	Crack-brained wit.
γ Ecstatica.	False inspiration.
δ Fanatica.	Fanaticism.

These species are thus graphically described by Dr. Good in his Study of Medicine.

"α *A. elatio heroica.* The age of the first of these varieties, that of chivalry or romantic gallantry, has nearly if not altogether departed. It may be regarded as a generous and high-spirited flight of the imagination, that gives a visionary colour-

ing to the external world, and combines, without a due degree of discrimination, ideas of fact with those of fancy. Like many of the varieties of empathema or ungovernable passion, it may lead to or be combined with ecphronia or insanity.

I have sometimes had to attend patients who, having spent the greater part of their days and nights over the most captivating novels of the present day, had acquired so much of this falsity of perception as to startle their friends around them, and to give evident proof, that they were of a mind occasionally deranged, though, when the attention could once be seriously engaged, capable of being brought down to the soberness of external objects and real life. These have commonly been ladies unmarried or without a family, about the middle or a little beyond the middle of life, of a nervous temperament, fine taste and fancy, but whose education had been directed to subjects of superficial or external ornament, rather than of intrinsic excellence. Their manner has been peculiarly courteous, their conversation sprightly and figurative, and their hand ready to aid the distressed. But it has been obvious, that in all they were saying or doing they had some ideal character in their minds, whose supposed air, and language, and manners, they were copying; and the distressed were always most sure of relief, and of a relief often beyond the necessity of the case, whose story was combined with some perilous adventure, or sentimental catastrophe.

In former times, however, when the wild and daring spirit of romance formed the subject of popular study, and

> The spinsters, and the knitters in the sun,
> And the free maids that wove their threads with bones,
> Were wont to chant it,

this bewildering triumph of the imagination over the judgment was far more common, and carried to a much higher pitch. The high-toned and marvellous stories of La Morte d'Arthur, Guy of Warwick, Amadis of Gaul, The Seven Champions of Christendome, and the Mirror of Knighthood; the splendid and agitating alternations of magicians, enchanted castles, dragons, and giants, redoubtable combatants, imprisoned damsels, melting minstrelsy, tilts and tournaments, and all the magnificent imagery of the same kind that so peculiarly distinguished the reign of Elizabeth, became a very frequent source of permanent hallucination. The historian of Don Quixote adhered strictly to the tenour of his times in representing the library of this most renowned knight as filled with romances of this description, and himself as being permanently crazed by an uninterrupted perusal of them. And that the same morbid effect was not confined to Spain, and was, indeed, common to our own country, we know from the severe but just invectives of Ascham against this class of writings, and his complaints of the disordered turn they had given to the public mind; and still more from the necessity Shakspeare felt himself under in making all his maniacal characters, whether really or but pretendedly so, deeply versed in the prose or poetical romances of the day, and throwing forth fragments of exquisite force or beauty in the midst of their wildest and most discordant ravings: Lear, Edgar, and the heart-broken Ophelia are in this respect alike gifted, and show to what sources their reading had been directed. Without an attention to these casual glances, it is impossible to understand the meaning of the sentiment, and its force or feeling is lost upon us, as in the following burst of Ophelia, which consists of a string of quotations, or allusions to picturesque customs:

> "You must sing *Down a-down an you call him adown-a.* O, how the wheel becomes it! It is the false steward that stole his master's daughter."

We have not space for the explanation, but it may be found in the commentators, or in the interesting and elaborate history of "Shakspeare's Times," by my early and valued friend Dr. Drake.

β *A. elatio facetoso.* The second variety of the present species, that of crack-brained wit, is derived rather from the peculiar temperament of the individual, than from any particular habit or train of reading; for, in general, few persons have given themselves less time to read, study, or even think, than those who are possessed by it. It is characterized by high spirits, a sportive and rampant imagination, and a flow of facetious ebullient wit, incapable of restraining itself. It is hence often poured forth on most improper occasions, and hesitates not to sacrifice a friend at the shrine of a jest.

There are some persons, who possess by nature so perpetual a tide of excitement, that their high spirits seem seldom or never to ebb, and so irresistible a propensity to this kind of verbal merriment that no change of circumstances can deprive them of it. Sir Thomas More, who perhaps overflowed with this disposition in a very high degree, is well known to have been facetious on his own scaffold.

It is not always, however, nor, as we

have just observed, even for the most part, that the man of ready wit is, like Sir Thomas More, a man of ready judgment, or sound learning. The apprehension, necessary to constitute the one, is widely different from that necessary to constitute the other, as we had occasion to remark under a former genus: and hence vivacious sallies, taunts, and repartees not only may co-exist with a deranged condition of mind, but are frequently a result of it. And on this account the court jester of former times, whose office succeeded to that of minstrel, was commonly denominated the king's fool, as uttering from the unbridled liberty of speech that was allowed him, humorous flashes of rebuke, which no man in his sober senses would have ventured upon; and which seemed, to adopt the language of Jaques, who was himself not unjustly accused of wearing the same livery, to show that

> in his brain,
> Which is as dry as the remainder biscuit
> After a voyage, he hath strange places cramm'd
> With observation, the which he vents
> In mangled forms.

γ *A. elatio ecstatica.* The third variety, or ecstatic illusion, is also a pleasurable hallucination; and consists in a sense of false inspiration, or a visionary boast of some preternatural endowment, in the course of which the judgment is so far perverted as to mistake the energetic notions of the imagination for realities; so that the victim of the delusion believes in apparitions, affects an intercourse with the world of spirits, or lays claim to a power of working miracles.

This morbid afflatus has often been aped by cunning impostors to serve their own interests with the multitude: and there is no great difficulty in conceiving, that it is in many cases a real and serious hallucination, when we reflect on the ease with which such impostors themselves are capable of deluding the populace and working them up into false ecstasies, and especially of inveigling them into a hearty belief of their own miraculous powers. When the passions of men are once set afloat, and the subject presented to them is full of the marvellous and the terrible, they are too apt to confound the false with the real, and are prepared to proceed to whatever extremities the magician may choose to lead them. We are told by Lucian that when Archelaus, a celebrated Greek actor, performed the part of Andromeda in the tragedy of Euripides, several of the spectators were seized with a delirium; some, at the time of performance, others, a day or two afterwards; during which they did nothing but declaim in a theatrical manner, and piteously lament the fate of the persecuted princess. Burton, therefore, has some reason for remarking, that what the impostors before us, or the brain-sick enthusiasts whom they imitate, once broach and set on foot, "be it never so absurd, false, and prodigious, the common people will follow and believe. It will run like murrain in cattle, scab in sheep. Nulla scabies superstitione scabior; as he that is bitten by a mad dog bites others, and all in the end become mad. Either out of affection of novelty, simplicity, blind zeal, hope and fear, the giddy-headed multitude will embrace it, and without farther examination approve it." (*Anatomy of Melancholy.* Part III. sect. iv. 1. 3.)

The genuine enthusiast is always possessed of a warm imagination, and generally of a nervous temperament, and delicate frame; and a long series of elevated abstraction on religious subjects, combined with protracted fasting, has ordinarily been the harbinger of the fancied afflatus. Such was the discipline by which the lovely, and blooming, and sincerely devout Saint Teresa was prepared for ecstasies and visions, and led to impose upon herself and all that beheld her; and seriously to believe, in the fervour of her mind, that her body was lifted from the earth: and that she heard the voice of God, saw our Lord with St. Peter and St. Paul standing on her left hand; by the first of whom the cross, which was at the end of her beads, was miraculously transformed into four large gems, incomparably more precious than diamonds; with many other marvellous revelations, which we cannot find room to detail. Though it should be noticed, that devils appeared to her as well as blessed spirits, whom she always kept at a distance by sprinkling holy water; and that she was an eye-witness to the joyful escape from the flame of purgatory of the purified souls of father Peter of Alcantara, father Ivagnez, and a Carmelite friar. (*Butler's Lives of the Saints*, in loco.)

It is not necessary to produce other examples, though many might be brought from our own times. A cure is extremely difficult to be obtained; and I am afraid that even Mr. Locke's admirable chapter on Enthusiasm would be read to no purpose. In one instance, the enthusiast seems to have been brought home to himself by a pleasant and ingenious stratagem of his superintendent at Venice. This

visionary had conceited himself to be Elias, and, like the prophet, had determined upon fasting forty days. The keeper, fearful that he would never hold out, and that he should lose his patient, dressed up a man in the attire of an angel, who was introduced to him in no ordinary manner, and informed him, that he was commissioned from Heaven to bring him food. The suppositious Elias took it, was afterwards allowed to find out the trick, and thus, at the same time, found out his own imposition upon himself.

δ *A. elatio fanatica.* From the influence which we have seen such enthusiasts, or even pretended enthusiasts, capable of producing upon the mind of the multitude, when roused by the solemnity and awfulness of the revelations that are supposed to be disclosed to them, we can easily see how fanaticism, constituting the fourth variety of the present species, may obtain an ascendency, and even rage with all the ramifying power of an epidemic: consisting of religious flights of the imagination, predominant over the natural feelings as well as the judgment, excited by the calls or doctrines of those who affect to be preternaturally gifted, or who possess an equal influence over the mind by the high sanction of priesthood, profound learning, or any other respected authority: and often urging to a voluntary and inappropriate submission to severe privations, mortifications, and tortures; or to the torture and massacre of those who profess different creeds.

Examples, as in the last variety, may be found in every age and religion, but chiefly in times of gross ignorance and barbarism; where the general mind has been too little informed to distinguish between truth and sophistry, and the passions have been undisciplined to restraint. It is hence of no importance what religion or superstition is to be inculcated; for those that are true, and those that are false, have been equally laid hold of by enthusiasts and impostors to produce the same end, and effect the same triumph by means and machinery that could only be furnished from the infernal regions. Hence the blood and raving of the prophets of Baal; the Curetes or Phrygian priests, and the delirious votaries of the Indian Juggernaut; the cruel and senseless penances and punishments sustained in many of the convents and nunneries of Lamism, and still more so in those of many Catholic countries. Hence the terrible sufferings of the Waldenses, the furies of St. Bartholomew's day, the fires of Smithfield, and the dark and doleful cells, the whips, and wires, and pincers, and pullies, and all the infernal paraphernalia of the Inquisition. Hence, in ancient times, the matrons of Canaan and of Carthage were instigated to throw their own children into the flames, and sacrifice them to the gloomy deity whose anger it was held necessary to appease; and hence in more modern days, Philip II. of Spain was goaded to impeach a son, of whom he was little worthy, before the Chamber of Inquisitors, to bespeak their condemnation of him, and to take effectual care that he should be poisoned, as soon as his sentence had been pronounced.

The cure of these diseases belongs rather to colleges of general instruction, than of medicine. Individual cases of enthusiasm and fanaticism have existed, and will probably continue to exist, in all ages; but when the general mind is well informed, and the social feelings and virtues are duly estimated and widely cultivated, the wild-fire will burn in vain, and meet with little or no fuel to support its rage."

I. H.

ALVEOLAR. Appertaining or relating to the alveoli. I. H.

ALVEOLUS. (Diminutive of *alveus*, a cavity.) This epithet is given to the cavities in the margins of the two jaws, in which the roots of the teeth are lodged. See *Bones*. I. H.

ALVINE. (From *alvus*, the abdomen.) Relating to the abdomen. Alvine dejections, the feces. I. H.

ALYSMUS. (From αλυω, I am restless.) αλυσμος, Gr. Restlesness, inquietude. Swediaur has applied this epithet to a genus of diseases. Obsolete. I. H.

AMAUROSIS. (From αμαυροω, I obscure,) αμαυρωσις, Gr.; *Gutta serena*, *Suffusio nigra*, Lat.; *Amaurose*, Fr.; *Die Schwarze Staar*, Germ. This epithet is applied to designate the partial or total loss of sight, resulting from an impairment of the nervous apparatus of vision. A knowledge of this apparatus is consequently an essential preliminary to the study of Amaurosis. It would be out of place, and involve repetition, however, to treat of that subject here; this will be more properly done in the articles *Eye* and *Vision*, to which we must refer. There are a few considerations, however, of so much importance, and a knowledge of which is so necessary for the perfect understanding of the subject of this article, that it is requisite to invite attention to them.

For the perfect performance of vision, it is necessary that the retina be capable of receiving correctly the impressions of

the rays of light; that the optic nerve be able to transmit these impressions to the sensorium, and that the cephalic organs, (the anterior tuberculi quadrigemina, the corpus geniculatum externum and the tuber cinerium, the portions of the cerebrum destined for that purpose,) be capable of receiving them. The organs just enumerated, may be considered as the especial, but not as was formerly believed the exclusive, apparatus of vision. For the performance of this function, the concurrence of other nervous organs is requisite. The sensibility of the retina is due to the fifth pair of nerves; without whoseconcurrence, the retina is incapable of acting as a sentient organ, as is amply proved by the experiments of Majendie, Bell, Desmoulins, &c.; and further by the consequences of injuries of this nerve. The retina is, moreover, in communication with other nerves, and there is reason to believe it to be, to a certain extent, subject to their influence. The connexion between the retina and great sympathetic appears to be well established. Branches of the latter may be traced upwards, from the first cervical to the cavernous ganglion, whence branches pass to the lenticular ganglion, and M. Ribes (*Mem. de la Soc. Méd. d'Emulat.* VII. 99,) and others, have shown that filaments proceed from this last named ganglion to the iris, giving more minute branches, in their course, to the retina. Branches from the cavernous ganglion also communicate with the third, the first division of the fifth,and the sixth pair of nerves. Further, the ophthalmic artery, with its ramifications to the iris and retina, is invested with filaments of the sympathetic. It will not consequently excite surprise, that morbid states of the sympathetic should impair the sense of sight; that it does so, is shown by the experiments of Mayo, (*Anat. and Physiol. Comment.* No. II. p. 4.) He found that when the great sympathetic is divided on one side of the neck of a dog, the pupil becomes fixed and contracted, and the nutrition of the eye interrupted. If the experiment be performed on both sides, the pupils become fixed and dilated. F. Petit has shown that the section of the cervical portion of the great sympathetic occasions dimness of vision, (*Acad. Roy. des Sc.* 1727;) and this explains the impairment of sight, which results from some wounds of the neck.

The retina, optic nerve, and cephalic organs of vision, being thus the especial nervous apparatus of sight, its entire integrity is necessary for the perfect performance of this function; and every pathological condition of any one of the organs which constitute this apparatus, will occasion an impairment of vision, or its entire loss—and it is to designate the blindness resulting from these causes, that the term amaurosis is employed. The first branch of the fifth pair, the third, sixth, and great sympathetic nerves concur in this function, hence its integrity is also impaired by various lesions of these nerves. It will thus be perceived, that amaurosis does not consist in a particular pathological condition of a single organ, but that it is a result of various morbid states of one or more of several different organs. Amaurosis, it must consequently be manifest, is not a disease, as it is usually considered, but a symptom—it is one of the ultimate results of diversified and even opposite pathological states, as will be hereafter shown, of several organs. This appears, to us at least, to be the true view of the subject, and to be the only mode of considering it, which can disembarrass it from the difficulties and obscurities in which it has hitherto been involved. If the morbid conditions productive of this symptom were well determined, all that would be necessary here, would be to refer to the articles on the several pathological states of the organs concerned in the function of vision. In the present imperfect state of our knowledge of the functions of the nervous system, this cannot be done with perfect precision, and on this account we shall devote some pages to the consideration of this symptom.

General description of Amaurosis; its march, duration, varieties, predisposing causes, &c.—Amaurosis consists in an alteration of the function of vision, which is impaired in all possible ways and degrees—there is a defective perception of the form, colour, and proportion of objects; in the relation of these last to each other; an augmented or diminished sensibility to light; and perception of the most various imaginary objects and colours. At the commencement of this affection, there is often only a slight dimness of sight; objects are seen but imperfectly; they appear more or less obscured by a cloud or haziness; the letters of a book appear confused, indistinct, and run into each other; the eye is soon tired, and waters, or becomes blood-shot if exertion be continued. The failure of vision in some instances is at first only occasional, for a short time, and after longer or shorter intervals, (*amaurosis vaga*); at others it is partial, or ex-

tends to a part only of the field of vision. Sometimes near objects are not clearly seen, whilst those more distant are perfectly distinguished, (*presbyopia;*) at times the reverse occurs, (*myopia.*) In some cases, there is at the commencement great increase in the sensibility of the retina, amounting to real intolerance of light, (*photophobia.*) Under such circumstances, the patient sometimes discerns for a short time, that is, for a few moments, or more rarely for a longer period, even the smallest objects in an extremely weak light, as clearly as the best eye can see them in the light of day; while, at other times, he cannot distinguish even larger things in the same light. (Beer, *Lehre*, II. 326.) This increased sensibility of the retina may become so considerable, that the presence of light cannot be borne; at least it causes severe pain in the eye and brow, with discharge of tears, and confusion of all objects. Mr. Lawrence has seen a patient in whom, although amaurosis had existed for some time, and advanced considerably, the smallest light could not be borne; and he remained constantly in a room with the very crevices of the shutters carefully stopped up. (p. 509.) When this exalted sensibility of the retina increases, a shining glare appears before the eye, sometimes with rainbow colours, occasionally tremulous, surrounding and confusing objects. A light cloud may pass before the eye; or luminous and fiery points, flashes, or streaks, may be seen. Blue or yellow flashes, or globes of fire, are seen in the dark, or when the lids are closed. This glare of light, and these various luminous appearances, often continue when the sensibility of the retina has been completely extinguished, and lead the patient to indulge in the hope that his vision may be restored. (Lawrence, p. 509.)

More commonly, the sensibility of the retina, instead of being increased, is diminished; involving the necessity of a powerful impression to produce any effect, and leading the patient in attempting to distinguish objects to seek as much light as possible.

In addition to the defects of sight, (*vitia visus,*) just noticed, various others may be enumerated as resulting from impairment of the nervous apparatus of vision. Objects are sometimes perceived with prismatic colours, or halos around them; sometimes they appear completely altered in colour; for example, as if seen through a yellow glass, (*visus coloratus, chrupsia.*) A very frequent phenomenon is broken or interrupted vision, (*visus interruptus.*) The eye misses parts of objects; letters or words are lost in reading, and the patient moves the whole head to search them out. Sometimes the upper or lower half, or the right or left half, is not seen, (*visus dimidiatus; hemiopsia.*) Sometimes a small part only of the retina retains its sensibility, and such things only are seen as are placed in a particular direction with respect to the eye. Slight movements of the head or eye, put the latter out of its proper position for vision, and it is not easily brought back again to its right place. Things sometimes appear deformed or distorted; crooked, mutilated, shortened, lengthened, or inverted, (*visus defiguratus, metamorphopsia;*) sometimes as if enveloped in a mist or cloud, which may be light, dark, or changeable, or apparently composed of minute objects coalescing; (*visus nebulosus.*) This cloud becomes thicker and more extensive, until the perception of objects is destroyed. A common symptom in incipient amaurosis, is the appearance of floating or moving bodies before the eye; (*visus muscarum; myodesopsia.*)—Dark or semi-transparent threads, spots, streaks, insects, rings, chains, and indeed minute substances of every description, seem to float before the eye, moving rapidly upwards and then falling, more conspicuous and more troublesome in impeding vision in a clear light, or in looking at a white or light object. A single black speck is called *scotoma;* the more numerous moving bodies are called *muscæ volitantes.* It is not uncommon for the patient to see before the eye a black disk, which increases in size as the affection proceeds, becoming larger and larger, until at last it covers the field of vision. As the moving bodies increase in number, they become more completely opaque, and unite so as to form a net or thick veil, more or less completely enveloping whatever the patient looks at (*visus reticulatus*). This net appears dark in a clear light, or against a white ground; while in the dark it is shining, and whitish or yellowish. Double vision (*diplopia, visus duplicatus*) is a common circumstance in incipient amaurosis. The affected eye deviates from its proper direction, or squints, so that the optic axes do not correspond. Hence objects are seen double; the two images sometimes being equally clear, though the second is generally fainter. The two may be close together, or at some distance; and the second may be above, below, or at one side of the first. When either eye is closed, vision with the other is single. The movements of the two eyes coincide

in certain directions, so that the double sight is only partial. In some instances the patient sees well during the day and is blind at night, *hemeralopia* (q. v.); or vision may be imperfect during the day and better at night, *nyctalopia* (q. v.)

The pupil and iris of amaurotic patients generally exhibit various conspicuous changes. The former is often considerably dilated, even in the strongest light; sometimes it is equally and permanently contracted. Its form is also often changed, being oval, oblong, or angular, at different points of its circumference. It may differ from its central situation in the iris, being most frequently displaced upwards and inwards: in such cases the margin generally presents irregularities. In many cases, the clear blackness which characterizes the normal state of the opening is lost, and the pupil has, instead, a dull, smoky, or cloudy discolouration of a greenish, grayish, or leaden cast; sometimes it is of a yellowish-green, much like that of glaucoma. The healthy retina is transparent, and the dark choroid seen through it gives the pupil its black colour. If the texture of this nervous expansion be changed by disease, a corresponding alteration in the appearance of the pupil may be expected. Beer states that the pupil may be reddish, or really red, or yellowish-white, in amaurosis, and that in such cases the discolouration is obviously in the fundus of the eye and concave. We have seen one distinct example of this, in which the lower and outer portions of the bottom of the right eye were of a bright red, and the upper and inner of a brilliant yellow, passing into a green. This is what Beer denominates amaurotic cat's-eye. Mr. Lawrence thinks that such appearances would denote organic disease of the eye-ball, rather than amaurosis, in the strict sense of the term. In the case to which we have alluded, the colouration was manifestly in or beneath the retina: the transparent tissues of the eye were entirely unaffected.

The iris was formerly very erroneously supposed to be motionless in amaurosis. In some individuals, whose sight is perfect, the iris possesses but little mobility; and occasionally it is motionless with unimpaired vision, (Lawrence, p. 514;) on the contrary, the full power of motion sometimes exists in complete amaurosis. (Janin, (*Obs. Chirurg.* fasc. II. pp. 65, 66,) has mentioned two instances of this; two more came under the observation of Schmucker, (*Vermeschte Chir. Schrifter*, 13,) and several have been seen by Richter, (*Obs. Chir.* II. 63.) Mr. Shaw relates, (*Med. Chirurg.* Trans. XII. 188,) a case in which the vision of the right eye was entirely lost, although the eye appeared to be in every respect perfect; that is, whether the other eye was open or shut, the pupil of the blind eye contracted and dilated with perfect regularity. When the amaurotic eye was directed towards the sun, the sound one being closed, the pupil of the former contracted, and when the hand was put before the eye, it dilated. Yet, notwithstanding this sensibility of the eye to light, the power of vision was so completely lost, that although a lighted candle was brought close to the child's face, she was not sensible of it until she felt the heat of the flame. Mr. Lawrence relates the case of a lady 56 years of age, who had lost, without obvious cause, the sight of her right eye, and whose two eyes were so completely alike, that he could not discern which was amaurotic; the independent, as well as the associated action of the iris, was perfect, and both pupils were of the same size under similar circumstances. (*Treatise*, p. 515.) In a boy, totally blind from hydrocephalus, whose case is related by Mr. Lawrence, (p. 497,) the motions of the iris were unimpaired. Mr. Travers also records two cases of amaurosis dependent upon a circumscribed tumour within the orbit, pressing upon the optic nerve, in which the motions of the iris were "even vivacious." (p. 188.) Several instances of an active state of the iris, in cases of amaurosis, have also been seen by Mr. S. Cooper (*Surg. Dict.* I. 29.).

In many cases in which the affection is confined to one eye, the iris of the amaurotic eye moves in harmony with the other, after its independent action is destroyed. In complete amaurosis of old date, accompanied with change of colour in the iris, Mr. Lawrence has sometimes seen the associated action perfect, when the strongest light, directed on the affected eye with the other closed, has caused no sensation nor change in the state of the pupil (p. 515.).

No explanation has as yet been given, why the pupil should, in some cases of amaurosis, remain fixed and unaltered by the exposure of the eye to the different degrees of light, while in others it is as sensible to the stimulus of light as a perfect eye. We do not as yet possess any conclusive evidence on this question, but circumstances seem to prove thus far, that the motions of the iris depend upon other causes than merely the state of

the retina, and that they are probably entirely controlled by the ciliary nerves.

Amaurosis occurs at all ages, but it is most frequent at or after the middle period of life, especially about the cessation of menstruation in females. Sometimes it is congenital, and instances of this are recorded by GIBSON (*Ed. Med. and Surg. Journ.* VII. 398), MONTEATH (*Translation of Weller's Manuel.* II. 82), LAWRENCE (p. 516), &c.

BEER says that amaurosis often results from an hereditary predisposition (*Lehre.* II. 442), and in this he is sustained by LAWRENCE, who asserts that the influence of peculiar hereditary formation in predisposing to amaurosis is unequivocal. (p. 517.) The former writer relates that in one family, the females, even in the third generation, become completely and incurably amaurotic, as soon as menstruation ceases; but they who have borne children escape. M. SANSON has seen a family, consisting of a father and four children, two sons and two daughters, all of whom became amaurotic at the age of twenty-one years. (p. 98.)

The progress of amaurosis is exceedingly various. In some instances it occurs suddenly; we have met with one case in which it was instantaneous, and Mr. LAWRENCE has seen a few instances in which persons having gone to bed with perfect sight have been totally blind the next morning. Sometimes days, weeks, months, and even years, elapse before vision is altogether lost. Not unfrequently the imperfection of sight reaches a certain point and then becomes stationary. This affection may be simple, or complicated with glaucoma, cataract, hydrophthalmia, &c.; or it may be transient or permanent, periodical and even intermittent, coming on at regular or irregular intervals. A man, whose case is related by RICHTER (*Anfangsgr. der Wundarzn.* c. 3. kap. 14), became blind at twelve o'clock in the day, when the upper eye-lid used to hang down paralytic. The attack always lasted twenty-four hours. On the following day at twelve o'clock the sight used to return, and the patient then suddenly regained the power of raising the upper eye-lid, and he would continue able to see for the next twenty-four hours. Whenever he took bark, the length of the paroxysm was doubled, the interval remaining the same; that is, the patient was blind for forty-eight hours and retained his sight for only twenty-four. This writer states that periodical amaurosis commonly depends upon gastro-intestinal irritation, as from worms, &c., or irregularity in the menstrual discharge; but that sometimes it is manifestly a symptom of intermittent, the patient being blind during the paroxysm and regaining his sight as soon as the fit is over. BEER is of opinion that periodical amaurosis is chiefly observed in chlorotic, hemorrhoidal, hysterical, and hypochondriacal subjects.

Diagnosis. Blindness from defect in the nervous apparatus of vision, may be confounded, in some cases, with the same symptom resulting from cataract or glaucoma, but the diagnosis is usually not difficult. The colour of the pupil, which is whitish in cataract, and usually clear in amaurosis, will generally serve to distinguish the former from the latter. There is one variety of cataract, that termed black cataract, in which the diagnosis is not so readily formed; but this affection is rare, and on regarding the pupil in profile it will be observed to exhibit a metallic reflection like bronze.

When the amaurosis is complete, it may be distinguished from the blindness from cataract by a peculiar vacant stare very characteristic of the former. On entering a room, instead of looking at persons or surrounding objects, the eyes are directed forwards with the lids wide open, and fixed in a kind of gaze on vacancy. There is a want of movement in the eye-balls and the head, and a quiescence of all the external parts whose motions ordinarily harmonize with those of the direct visual apparatus, which immediately betray the state of the case even to an inexperienced observer. This vacant stare does not occur in cataract. Although the patient may be unable to discern objects, he looks about, as if conscious that vision still existed. In short, the state of the eyes, eye-lids, and surrounding parts, with the mode of carrying and moving the head, are expressive of blindness in the one case, of sight in the other. (LAWRENCE. p. 512.)

Amaurosis may be distinguished from glaucoma by the presence of the symptoms of the latter, in addition to impairment of vision. These symptoms are the deeply-seated green discolouration of the pupil, and the altered colour of the iris. If, as it sometimes happens, the pupil should be also dilated and fixed in the commencement of the affection, the distinction will be still more easy. The colour of the iris is not always changed in glaucoma; green discolouration of the pupil is sometimes seen in amaurosis, while a sluggish or motionless state of the iris and dilated pupil is common to both. Hence the distinction is difficult in some cases. It is more im-

portant in reference to prognosis than treatment; for the same means are applicable to both affections, though the chance of benefit is much less in glaucoma than in amaurosis.

When there is a wish on the part of the patient to deceive, as is sometimes the case, the diagnosis of amaurosis is exceedingly difficult, as there are often no symptoms positively indicative of the existence of amaurosis, at least none which cannot be simulated—the patient alone, can estimate justly, in most cases, the degree of diminution of sight or its total loss. The dilatation and immobility of the pupil, long considered as characteristic of this form of blindness, we have seen are not always present, and on the contrary sometimes exist without amaurosis, as in mydriasis or paralysis of the retina. It may be moreover simulated by introducing a few drops of extract of belladonna into the eye, or by taking internally some preparation of this plant. When, however, the patient possesses the power of seeing, it is not easy for him to resist an instinctive disposition to close the eye-lids when an unexpected menace is made to strike the eye. Great importance was attached to this by Morgagni and others, as a means of detecting simulated amaurosis; but experience has shown that it is not to be depended upon: A man of firmness and sufficiently practised, can support without wincing or closing his eye-lids the approach of a bright light or any object with which we may threaten to strike or seize the eye; moreover, when amaurosis is incomplete, the patient having some perception of objects, seeks to avoid, by closing his eyes, those which threaten to wound them; and finally, some patients who are completely blind, are endowed with such acuteness of sense, that they are aware of the approach of bodies which may injure them, and avoid such with great skilfulness. (Sanson. p. 104.)

Amaurosis having been discussed in a general way, it is now to be considered in reference to the pathological states from which it may arise. We have stated that for the perfect performance of vision, it was necessary that the retina be capable of correctly receiving the impressions of the rays of light; that the optic nerve be able to convey these impressions to the sensorium; that the cephalic organs be capable of receiving them; and finally that certain nerves distributed to the eye and which concur as accessories in the function of this organ, be in a normal state. This seems to suggest a natural classification, which, though it must be admitted not to be entirely faultless, since two or more of these organs may be affected at the same time, and causes which act upon one may have their action transferred to another, appears to us to be obnoxious to fewer and less serious objections than any other that we have seen proposed, and therefore we shall follow it.

1. *Amaurosis from lesion of the retina.* The retina is the seat of visual impressions, and every lesion of it, of whatever description, impairs the performance of its function. Amaurosis is hence a constant symptom of every morbid state of this organ. In the article *Retina, pathological states of,* the various morbid derangements to which this tissue is liable will be enumerated; all that will be requisite here is briefly to enumerate the morbid derangements which have been discovered on post mortem examination of patients who had been amaurotic. The retina has been found with its vessels injected, (Prochaska, Rognetta); separated from the choroid by varicose vessels, (Plouquet), by serous effusion, (Scarpa, Ware, Zinn, Wardrop, Heusinger), and by hydatids, (Portal); firmly adherent to the choroid by lymphatic exudation, (Graefe's *Journal*); thickened, firm, and opaque, (Portal, Sanson), converted into a white fibrous membrane, firm and like an aponeurosis, (Demours); with numerous blood-vessels and yellow spots, (Langenbeck); often green, (Sanson); ossified, (Haller, Morgagni, Rousseau, Sanson); partly fibrous and partly osseous, and of variable thickness, (Majendie); with transparent vesicles developed in it, (Haller, Morgagni, Heister, Zinn, Sanson); affected with malignant disease, (Wardrop); atrophied, (Beer, Wardrop, Scarpa); and Fabricius Hildanus, Heister, &c. have quoted instances in which it had even entirely disappeared.

Causes. Amaurosis being a constant result of every irritation of the retina, or its consequences,—derangement in the nutrition of this organ,—whatever is capable of exciting irritation in this structure, may be enumerated among the causes of amaurosis. The consideration of these agents more properly belongs to the subject of *Retinitis*, (see this article); but it appears expedient here, to inquire into the influence of certain causes supposed to induce amaurosis by acting upon the retina, without occasioning any lesion of structure in this organ. Beer, Benedict, and other German writers, maintain that amaurosis may be caused by various articles of food, and by many of the substances employed in medicine. Beer (*Lehre*, II. 445) enu-

merates among these, the vegetables which have the property of dilating the pupil; as belladonna, hyosciamus, stramonium, and cherry laurel; opium, succory-coffee, bitter beers, bitter almonds; gentian, quassia, simaruba, centaury, cynoglossum; ammoniacum and galbanum; and the various preparations of lead. The first four vegetables occasion a dilatation of the pupil, and as Mr. LAWRENCE (p. 523) observes, the attendant temporary confusion and diminution of sight seem to depend not upon any immediate influence exerted by those articles upon the retina, but on the dilatation of the pupil, and go off in proportion as that opening recovers its natural size, without any permanent injury to sight. It appears to us probable that in moderate doses these vegetables act principally upon the nerves of the iris, but in excessive doses they seem also to act upon the brain. CHRISTISON states that opium in large doses generally causes contraction of the pupil, which is sometimes excessive. (*Treatise on Poisons*, 2d ed. 648.) The facts collected by this learned writer seem to show that this drug produces no organic injury of the nervous apparatus of vision. The influence of the roots of the wild succory (often employed in Europe as a substitute for coffee) in producing amaurosis, seems, notwithstanding the assertion of BEER, to be extremely doubtful. BENEDICT (*Handbuch.* V. 97) has never seen a well-marked instance. Equally problematical is the influence of beer, bitter almonds, and the vegetable bitters and gums above enumerated. The researches of Dr. CHRISTISON afford no confirmation of the opinion of BEER, relative to the influence of lead over the functions of the retina.

Diagnosis. The retina may be suspected to be the organ affected, in those cases of amaurosis in which there is broken or interrupted vision, or in which portions only of objects are seen. It rarely happens that the whole of the retina is, from the commencement, equally affected, and hence objects are seen in certain positions better than in others. When this tissue is inflamed, the central portion of the expansion, which is the usual seat of impression, loses its sensibility first; the circumference, which does not undergo the same degree of habitual exertion, retains its powers longer. Hence patients can frequently see objects placed laterally, particularly on the temporal side, after the power of distinguishing them in the direct line of vision is totally lost. (LAWRENCE, p. 511.) (See *Retinitis.*)

Treatment. We have seen that the variety of amaurosis under notice, is one of the phenomena attending upon or resulting from irritation of the retina. The treatment will hence be more naturally considered under the head of *Retinitis;* all that we shall attempt here is to point out the general indications. In acute retinitis no difference of opinion exists as to the most active antiphlogistic measures being demanded. But in chronic retinitis, this is not the case, and we believe that the most injurious measures are ordinarily pursued for its cure. This form of retinitis is extremely insidious. There is little manifest inflammatory action; the nutrition of the part becomes deranged, the substance of the retina is changed—its fine pulpy texture is lost—it becomes incapable of receiving visual impressions, and sinks to the level of organs destined to fulfil less important offices. Patients here find that they have difficulty in perceiving objects in ordinary light, and that they require a very strong one for the purpose; hence they term it weakness of sight; suppose that their imperfect vision results from debility; and that the organ requires to be strengthened. Too many physicians give into this idea, and prescribe tonics and stimulants of all kinds, both local and general. The impropriety of such pathological views and the injurious nature of the practice which follows, have been strongly and judiciously commented on by Mr. LAWRENCE. (p. 507.) We are not prepared to aver that imperfection of sight is never produced by what has been called debility of the retina, but which would be more properly termed anemia of that tissue. The blood (white or red) is an essential constituent of the organism; in the structure of each tissue in a normal state, a certain amount of this fluid enters; if this quantity is in excess or defect, it equally constitutes a pathological condition. Now while it may be confidently asserted in respect to the retina that its morbid states are most usually the consequences of irritation, and *ubi irritatio ibi affluxus;* it is not to be denied that in some cases it may be in an anemic state. Such instances are, however, exceedingly rare, and are readily recognizable. They probably never occur except in cases of general anemia, and here the brain suffers even more than the retina; they will therefore be noticed under the variety arising from affection of the brain. (See also *Retinitis*, and *Anemia.*)

2. *Amaurosis from impairment of the optic nerve.* The integrity of the optic

nerves may be impaired by external injuries, as by fractures of the anterior basis of the skull, with displacement of the orbital parietes; and by punctured wounds of the orbit. They may be stretched, and thus rendered incapable of performing their functions, in consequence of the protrusion of the globe by accident or disease, and they may be also injured by tumours formed in their vicinity, and involving or compressing them in some part of their course. Tumours of this description have been found of various kinds. Thus they have been met with scirrhus, by PLATER, RIOLAN, WANDELER, &c.; steatomatous, by ŒHME; osseous, by HALLER, SCHMUCKER, BEER, &c.; tuberculous, by SAUVAGE; encysted, by PAW, SCHMUCKER, &c. BŒRHAAVE gives a case in which the optic nerve was compressed by an exostosis of the optic foramen; BLEGNY found a calculus near the origin of one of the optic nerves; and BEER has in three instances found hydatids between the coverings of the optic nerve, by the pressure of which the medullary matter appeared to have been displaced. Tumours of the pituitary gland also constantly produce incurable amaurosis more or less complete according to the volume of the tumour, by pressing on the optic nerve, as is shown by the observations collected by M. RAYER (*Archiv. Gén.* III. 350). It may be interesting to state that according to this writer, persons affected with blindness from this cause, exhibit an apathy and disinclination to move, quite characteristic. WEPFER, VIEUSSENS, DE HAEN, LEVEQUE-LASSOURCE, WARD, RULLIER, &c. have reported many cases of amaurosis from pressure on the optic nerves by the pineal gland in a state of enlargement and disease; and a very remarkable one is related by SANSON (*Dict. de Méd. et Chirurg. Prat.* II. 89), in which no trace could be discovered of this gland, but in its place there was found a cyst of the size of a small pullet's egg, filled in part with a liquid, fatty, yellowish matter, mixed with blood, and with a yellowish, solid, friable, caseous or tuberculous substance. Effusion into the ventricles may also occasion pressure on the optic nerves, and thus destroy their function. Hence amaurosis is a commom symptom in hydrocephalus. Mr. LAWRENCE states that "Mr. Langstaff's museum contains some specimens, in which the third ventricle is enlarged by the accumulated fluid, and its parietes bulged in front so as to press on the united portion of the optic nerves." (p. 496.) This distinguished surgeon relates also a case in his own practice, in which, on post-mortem examination, the same condition was observed. Another cause of this form of amaurosis is the aneurismal dilatation of the cerebral arteries. It was a conjecture of the late Mr. WARE that this symptom might not unfrequently be owing to the dilatation of the circulus arteriosus. "Should then the dilatation," he observes, "take place in the posterior portion of the circulus arteriosus, so as to compress the nervi motores occulorum, the consequence will be, that the eye-lids and probably the eyes also will lose the power of motion. But if the dilatation happens in the anterior portion of the circulus, as the compression will then be on the optic nerves, the sight must, of course, be destroyed. And should the dilatation take place in both portions, so as to occasion a compression both on the optic nerves and the nervi motores oculorum at the same time, while the eye-lids will thereby be rendered immovable, the eyes also will be deprived of sight and motion together. (p. 400.) A case of amaurosis from aneurism of the right anterior cerebral artery compressing the right optic nerve, is recorded by Mr. SPURGIN. (*Lond. Med. Repos.* June, 1825. p. 443.) In a preparation in the possession of Professor SCHMIDLER, of Friburg, taken from a princess of Baden, who was for a long time blind, there is an aneurism of the central artery of each retina compressing the optic nerves. (*Dict. des Sc. Méd.* XXXV. 20.)

The disorganizations observed in the optic nerve in this form of amaurosis, are exceedingly various. BOTAL, BUCHWALD, and GALLEREUX, have seen them softened and ulcerated; GALLEREUX discovered a hard, grayish tubercle of the size of a hemp-seed, in the left optic nerve of a patient affected with amaurosis of the corresponding eye. CHESNEAU found one of the optic nerves covered with a kind of gypseous crust; BONNET has seen these nerves firm and very friable; and this last author and BIRMINGER have found them twisted. RULAND saw one of them distended with serum; ZINN found the central artery and vein dilated. But one of the most frequent alterations met with, and of which instances have been seen by VESALIUS, SCULTETUS, CECALPINUS, RIOLAN, MORGAGNI, VALVERDE, SANTORINI, HEILAND, ISENFLAMM, ROLFINCK, and others, is the withering and atrophy of one or other of the optic nerves. (SANSON. *Dict. de Méd. et de Chir. Prat.* 87–8.) ROSTAN found these nerves flattened, diminished in calibre, in a state of atrophy, of a reddish appearance like a small arterial tube, and without any resemblance to the whitish cord which they ordinarily represent. (*Re-*

cherches sur le ramollissement du cerveau. 2d ed. 28—31.) Dr. MONTEATH, in a note to his translation of Weller's Manual of the Diseases of the Eye, states that on examining the sheaths of the optic nerves, he ascertained in one instance that their medullary matter had been completely removed; and a case is recorded by TRAVERS (*Synopsis.* p. 442–3) in which the optic nerves to and from the ganglion opticum were shrunk or rather absorbed; so that they appeared flat instead of cylindrical, and of a straw colour instead of a silvery whiteness. In slitting, and cutting them across, he says it was evident that only the sheath of the nerve remained, the medullary substance had entirely disappeared. DEMOURS found the nerve in nearly half its extent as it were in a state of suppuration, and reduced into a liquid of dirty white colour. (*Traité des malad. des yeux.* I. 74–6.) BEER (*Lehre*, II. 580–1) gives the following account of the morbid changes which he has met with in this form of amaurosis. "The diseased alterations which I have hitherto met with, have consisted of true induration of the optic nerve, and adhesion of it to the sheath. Within the cranium, the gray and completely shrunken optic nerves, as far as to their connexion with the brain, have been without a trace of medullary matter; the thalami nervorum opticorum have had their natural appearance; the neurilema has been destitute of medulla, tough, not easily torn, and has consisted of a simple vascular membrane. On one occasion, though both eyes were perfectly blind, and had been so for the same length of time, the nerve of the left eye only with its neurilema were in this state of atrophy as far as the sella turcica, while that of the right eye was indurated and closely adherent to its sheath, without being in the least shrunk. Between the union of the two nerves and the brain, they were in a perfectly normal state. The left corpus striatum was so hard that it required a strong and sharp scalpel to divide it, but its colour and form were natural. The plexus choroideus was wanting on this side. In three amaurotic patients of this kind, I found hydatids in the sheath of the optic nerve, the medullary substance being apparently pushed aside; and on the most careful examination, I could not discover the lenticular ganglion (*Augennervenknoten*)." (LAWRENCE, 503.)

Diagnosis. In speaking of the amaurosis which results from disease of the optic nerves or their sheaths, BEER states (*Lehre*, II. 578) that "it is developed slowly, commonly in one eye only, seldom in both. A black cloud appears before the eye, and becomes gradually thicker, while the patient experiences an annoying distortion of objects, without the smallest uneasy sensation in the eye or head; he only feels a slight sensation of pressure in the back of the orbit, as if the globe were pushed out of the socket, of which, however, there is no appearance. In the very beginning of the affection, the pupil is considerably dilated, and the pupillary margin of the perfectly motionless iris is angular at various points, so that the pupil often presents an irregular pentagon or hexagon. Gradually, but very slowly, a glaucomatous degeneration of the vitreous humour, and even of the lens, occurs, forming the only kind of glaucoma that I have hitherto seen without any varicose affection of the blood-vessels of the globe. At last the eye is visibly lessened, but complete atrophy does not take place." (LAWRENCE, p. 502.)

Treatment. It must be evident that little can be expected from medicine, in this form of amaurosis; all that can be done is to relieve some of the concomitant symptoms.

3. *Amaurosis from affections of the Encephalon.* Amaurosis is a constant result not only of all lesions of the encephalic organs of vision, as from plethora and its opposite condition anemia; from irritation and its consequences, congestion, softening, induration, suppuration, &c. but it is also produced by the compression of those organs from tumours of various kinds, tubercles, hydatids, fungous hematodes, sanguineous and serous effusions, abscesses, &c. in other parts of the brain; and finally, exostosis, caries or various sarcomatous growths of the bones, especially where these diseases are so situated as to interfere with the portion of the brain with which the optic nerves are in relation.

Plethoric persons are in general able to produce a degree of congestive amaurosis at will, by stooping, tying their neckcloth tight, and the like. (MACKENZIE, p. 796.) BOERHAAVE relates the case of a man, who, whenever he was intoxicated, laboured under complete amaurosis, which came on by degrees, increased with the quantity of wine, and after the intoxication went off, his vision returned. (*De Morb. Ocul.* p. 75.) On the contrary, temporary amaurosis is frequently witnessed from exhaustion. When syncope is produced by loss of blood, sight appears to be the sense which first fails, and which recovers last. Examples of amaurosis resulting from abscesses in the brain, are reported by BALLONIUS, (*Pa-*

radigmata, Hist. 7.); by PELARGUS, (*Med. Jahrg.* III. 198.); PEYRONIE, (*Mém. de l'Acad. Roy. de Chir.* I. 212.); SCHAARSCHMID, (*Berlin Nachrichte*, 1740, No. 26.); LANGENBECK, (*Neue Bibl.* I. 61.); and Mr. TRAVERS, (*Synopsis*, 143.) The latter author has recorded an instance in which a firm lardaceous tumour, of the size of a garden bean, situated on the same side as the blindness, compressed the optic ganglion and nerve at its origin from it. (p. 151.) Mr. S. COOPER has seen a case of amaurosis in which a tumour as large as a middling-sized apple was found in the anterior lobe of the brain, attended with protrusion of the eye and vast destruction of the bones. Mr. TRAVERS has seen amaurosis produced by a medullary fungus of the brain. A case occasioned by disease of the thalamus, is related by VILLENEUVE (*Journ. de Méd. continué*, 1811, Feb. p. 98); another of a tumour of the thalamus on the same side as the blindness, is recorded by FORD (*Med. Commun.* I. No. 4); and other swellings in various parts of the brain are described in *Ephem. Nat. Cur.* Dec. 3. Ann. 9 and 10. Obs. 253; DE HAEN's *Ratio medendi*, P. 6. p. 271; *Journ. des Scavans*, 1697; MUZELL's, *Wahrnehm.* II. No. 13; PLATER, *Obs.* I. 108; THOMANN, *Annalen* für 1800, p. 400, &c. (COOPER's *Surg. Dict.* I. 42.)

For practical purposes, it will be convenient to arrange the lesions of the brain which give rise to amaurosis, in three classes: 1st. Degenerations both of the cephalic organs of vision and of the other parts of the brain; 2d. Congestion, whether resulting from irritation, general plethora, or impediments to the circulation; and 3d. Anemia of the brain. This is manifestly not the place to enter into the consideration of these affections. (See *Brain*, *Tumours*, *Plethora*, *Anemia*, &c.) But as in amaurosis from these lesions, the treatment must in many instances be regulated by the causes which give rise to them, it may be expected that we should briefly enumerate those causes.

The first class of disorders may be produced by all causes capable of exciting irritation of the brain, and deranging its nutrition; as external injuries, and the long-continued action of the causes next to be enumerated. The causes of the second class, are general plethora, or whatever tends to favour congestion in the brain, as occupations requiring a stooping posture, lying with the head very low at night, pressure on the jugular veins by tumours, or other impediments to the flow of blood from the head; prolonged exposure to the sun, forced exertions of the mind, excess of passion; the pregnant and puerperal states; suppression of accustomed discharges, as of hemorrhages, or from hemorrhoidal humours, of perspiration, of the menses, of the secretion of milk, of the lachrymal secretion, or that from the Schneiderian membrane; the stoppage of suppuration from the ear, the drying up of issues or of old ulcers; the suppression of cutaneous eruptions; the excessive use of stimulants; the deglutition of poisonous substances, as belladonna, stramonium, solanum dulcamara, fish poison, various fungi, animal poisons, opium, tobacco, the excessive use of snuff, &c.; and occasionally by certain articles of diet. BEER states that he had twice under his care, a female who was attacked with amaurosis whenever she drank chocolate, and that on leaving off this food, she never afterwards had any complaint of her eyes. In this class may also be enumerated, a loaded state of the bowels, and the irritation of these organs by worms, and indigestible or foreign matters. It is well known that the presence of worms in the intestinal canal sometimes gives rise to all the symptoms of hydrocephalus, strabismus, impaired vision, &c. A case of complete amaurosis in a child, which was instantly cured on a worm being puked up, is recorded by Mr. WELSH, (*Trans. of Massachusetts Med. Soc.* I. 87); and another is related by Mr. LAWRENCE, in which this symptom immediately disappeared on the rejection from the stomach, by vomiting, of a bead. Metastasis to the brain of rheumatism and gout, seems also to be a cause of amaurosis, though the existence of such an affection as gouty or rheumatic amaurosis, as described by BEER, has been justly doubted by Mr. LAWRENCE.

The causes which induce anemia of the brain, or exhaust the vital energies of this organ, are excessive hemorrhage, leucorrhœa, menorrhagia, diarrhœa, and other discharges; profuse secretions of urine (diabetes), of saliva (ptyalism), of seminal fluid from too frequent venery, or from masturbation, of milk from protracted suckling, &c.; and in this category are usually arranged typhoid fevers.

The diagnosis of this form of amaurosis can only be determined from a careful and minute investigation into the history of the case, and will often be involved in great obscurity, both from the inherent difficulty of the subject, and the inaccuracy with which patients describe their feelings, and the imperfect account they give of the progress of their symptoms. When amaurosis arises from morbid changes in the brain or skull, it usually attacks, according to BEER,

both eyes together, or at least one very soon after the other; the blindness also commences very slowly, with appearances as if every object looked at were perverted or disfigured. There is, however, no black cloud, but rather an obscurity or confusion of every object. The disease in this stage is also accompanied with frequent giddiness, ugly luminous spectra, and, for the most part, with aversion to light, uncommonly lively motions of the iris; a contracted pupil, angles in the upper and lower portions of the pupillary margin of the iris; an evident turgescence of the bloodvessels of the eye, gradually augmenting with most violent head-ache into actual cirsophthalmia; frequent convulsive motions of the eye and eyelids, and strabismus of one or both eyes, ending in a true deviation of one or both of these organs from their natural positions. Under these symptoms, vision is afterwards entirely abolished; and the head-ache, though subject to remissions, grows so much worse, extending back to the spine, that the patient is often nearly frantic, and, indeed, after a time, a destruction of the external senses takes place, followed by that of the intellectual faculties. The first of the external senses lost, is always the hearing, which infirmity is next followed by loss of smell, or taste, or both these senses together, and then the memory, and other intellectual powers, decline. In this stage of the disorder, the eyeball not unfrequently protrudes from the orbit, a pathognomonic symptom, to which Beer attaches great importance as an infallible criterion of a diseased state of the bones of the orbit, of the parts which invest this cavity and of the optic nerve and dura mater, in the sella turcica. In such cases, complete mania now usually follows, and this sometimes in its most violent form, unless the patient happen to be first carried off by paralytic symptoms; life, under these circumstances, never lasting any considerable time. (Cooper's *Surg. Dict.* I. 42).

Treatment. The treatment of amaurosis has been, almost without exception, entirely empirical; but in none of the forms has it been more so, than in that under consideration. To enter into the consideration of all the measures that have been employed for the relief of this symptom, would occupy many pages, and be productive of little advantage, as authors have not designated the forms of amaurosis in which the remedies they have administered were successfully employed, and the tentative practice hitherto resorted to, is not only discreditable to the practitioner, but often subjects the patient to great distress and protracted pain, without affording the slightest relief. It is only by acquiring a knowledge of the pathological state from which this symptom results, and the cause of that pathological condition, that we can hope to arrive at any rational method of treatment, or be enabled to determine the cases which are curable, and those in which the subjection of the patient to severe remedies is an unjustifiable piece of cruelty. From the extremely diversified and even opposite conditions which give rise to this symptom, relief has sometimes followed the administration of a great variety of remedies, and of very different properties; and as the character of the cases has been but imperfectly or not at all designated, each of these remedies has been highly lauded by the successful employer, as a cure for amaurosis; whilst constant disappointment has resulted from its administration by others. If amaurosis is, as we think that we have shown it to be, not a disease, but a symptom resulting from various causes, this disappointment need not create surprise. The details of the treatment of this symptom belong to the affection from which it arises: all that can be required here, is, after pointing out these affections, to notice the general indications for the cure.

Amaurosis resulting from the first class of causes, is for the most part hopeless: it is here but one, and often not the most important of the evils produced by degeneration of the brain or its envelope, and requires no special treatment.

The treatment of amaurosis from the second class of causes, must to a considerable extent be regulated by the particular cause. General plethora is to be relieved by bleeding, general and local, low diet, and the usual antiphlogistic measures: (see *Plethora*). Local plethora is to be removed by topical bleeding, and revulsives, and the removal of the cause of the congestion. Stooping postures, or whatever favours the flow of blood to the head, should be avoided. When there has been a suppression of an accustomed discharge, this should be restored, or another substituted in its place. When it results from the ingestion of a foreign or poisonous substance, the stomach should be emptied by an emetic; when from worms or a loaded state of the bowels, the latter should be evacuated by proper remedies: (see *Worms*, *Constipation*, &c.). Great confidence has been placed in emetics, followed by what are termed resolvents, by Schmucker, Rich-

TER, and SCARPA, not only in those cases in which the symptom manifestly arose from sympathy with disordered stomach, but generally in cases of imperfect amaurosis. SCHMUCKER (*Chirurg. Wahrn.* Th. I.) states that he has often seen soldiers become suddenly blind on forced marches, particularly in hot weather, and when they had much to carry. A venesection immediately, and the day after three grains of tartar emetic, generally restored sight. If recovery did not take place, the jugular vein was opened, the medicine repeated the following day, and a blister applied; which means were generally successful. The other remedies had probably more to do with the cure than the emetic. Sometimes this writer gives the Tartar Emetic so as to produce only nausea. RICHTER (*Anfangsg. der Wundarzneykunst.* III. § 448) recommends emetics and purgatives where there is reason to suspect the existence of acrimonious matters in the primæ viæ; and he relates elsewhere (*Comment. Soc. Reg. Scient.* Gœtteng. IV.) the case of a patient, who had become blind after being in a violent passion, whom he restored to sight by an emetic administered the following day. SCARPA (*Treatise*, p. 458, &c.) says that, "by an attentive examination of the nature and causes of the imperfect amaurosis which admits of a cure, it is found, from the careful observations of SCHMUCKER and RICHTER, that this disease is most frequently derived from a morbid excitement or irritation in the digestive organs, from sordes, or from worms, especially in children, either alone, or accompanied with general nervous debility, in which the eyes participate sympathetically. Agreeably to these principles, in the greater number of cases of *recent imperfect amaurosis*, the principal indication of cure which the surgeon ought to fulfil in the treatment of this disease, is that of unloading the stomach and primæ viæ of the crudities, worms or morbific stimuli, and afterwards of strengthening the gastric system, facilitating the digestion, and at the same time exciting the whole nervous system, and particularly that of the eyes, which are affected and rendered torpid by a sympathetic connexion."

"With respect to the first part of the treatment of imperfect amaurosis," he adds, "the intention is perfectly answered by emetics and internal resolvents (antiphlogistic purgatives). In the class of emetics experience has taught that the antimonium tartarizatum, is preferable to every other, and that when given afterwards, in small and divided doses, it answers the purpose of a resolvent medicine, the action of which may be increased by conjoining it with gummy or saponaceous substances. In the treatment of the imperfect amaurosis, therefore, which is most frequently sympathetic, and depending on acrid matters in the primæ viæ, it will be proper at first, in the greater number of cases, to dissolve, for an adult, three grains of tartarized antimony in four ounces of water, of which two table-spoonfuls may be taken every half-hour, until it produces nausea, and afterwards abundant vomiting. On the following day he should be ordered to take the resolvent powders, composed of one ounce of the crystals of tartar, and one grain of the tartarized antimony, divided into six equal parts, of which the patient should take one in the morning, another four hours afterwards, and the third in the evening, during eight or ten successive days. This medicine will usually produce a slight nausea, and some evacuations of the bowels more than usual, and perhaps, after some days, even vomiting. But if, during the use of this opening powder, the patient make ineffectual efforts to vomit, and complain of a bitter taste and want of appetite, without any amendment of sight, the emetic should be repeated, and even a third and fourth time, if the presence of the morbific stimuli in the stomach, bitter taste, tension of the hypochondria, acid eructations, and tendency to vomit, require it. For it not unfrequently happens, that the patient, on the first action of the remedy, throws up only water, with a little mucus; but on repeating the emetic, after the nauseating powder has been used for some days, a considerable quantity of yellowish-green matter will be thrown up, which will greatly relieve the stomach, head, and eyes." (p. 458–460.)

"The respect," observes Mr. LAWRENCE, (p. 544), "justly due to the names of RICHTER and SCARPA, would naturally lead us to try a mode of treatment which they have so strongly recommended. I have accordingly employed their plan in some instances which appeared favourable, but entirely without success. I have seen no case of amaurosis cured, nor even relieved, by such measures. On the contrary, after the ineffectual trial of emetics and nauseants, I have removed the disease by the abstraction of blood, and the other treatment already described. I have therefore entirely abandoned the use of emetics in amaurosis. I should not consider them safe, if general plethora, determination to the head, or active disturbance of the retinal circulation, were present." Except, in-

deed, in the cases we have indicated, that is, where amaurosis results from the presence of a foreign or poisonous substance, little, we should conceive, can be expected from emetics, and where there is confirmed gastric irritation, the tartar emetic must of course aggravate it.

Amaurosis from the third class of causes, requires tonics, and a removal of the debilitating causes from which it originates. If from protracted suckling, the child must be weaned; if from profuse evacuations, they must be arrested. It is sometimes necessary, however, in addition to these measures, to resort to revulsives, and even sometimes to topical depletion; while at the same time, tonics, a nutritious diet, &c., are administered. Mr. MIDDLEMORE recommends in these cases the endermic application of strychnia immediately above the eye-brow. (See *Anemia*, *Suckling*, &c.)

3. *Amaurosis from lesions of the accessory nervous apparatus of vision.* We have already shown that this apparatus consists of the fifth pair of nerves, the great sympathetic, and the third and sixth pair of nerves. We shall consider the effects upon vision of the lesion of each of these nerves, separately.

A. *From lesion of the fifth pair.* It has been known since the earliest periods of our science, that injuries in the neighbourhood of the fifth pair of nerves impaired vision, though the reason why this occurs is the discovery of modern times. Thus, HIPPOCRATES observes, "The sight is obscured in wounds which are inflicted on the eye-brow, or a little higher." (*Coan Prognostics*, No. 510.) Examples of amaurosis from this accident have been recorded also by MORGAGNI, CAMERARIUS, PINEL, SABATIER, BEER, WARDROP, TRAVERS, MACKENZIE, &c., and we have ourselves repeatedly met with them. Injuries, compression, and even irritation of this nerve, from organic lesions of the brain, or its membranes, the bones of the cranium, or parts in the course of its branches, seem to be constantly attended with impairment of vision. Dr. COPLAND has met with a case in which the sight of one eye was nearly lost in consequence of the pressure upon the frontal branch of the fifth pair of that side, by a common boil; when the boil broke, vision was soon restored. The extirpation of a cyst, situated three inches above the left eye-brow, was, in a case related by DEMOURS, followed by amaurosis the day after the operation.

The impairment of vision, from wounds of this nerve, sometimes instantly follows the accident, at others it does not come on until long after the wound has healed; and according to WARDROP (II. 180), it is only when the frontal nerve is wounded or injured and not entirely divided, that amaurosis is produced; for he says that impairment of vision following a wound of this nerve may be sometimes cured by completely dividing the trunk nearest its origin. "A gentleman received an oblique cut in the forehead, which, from its direction and depth, must have injured the frontal nerve. The wound was not accompanied by any severe symptoms, and soon healed. But afterwards the vision of this eye began to fail, and in a few months was completely destroyed; the pupil was much dilated, the iris was not influenced by variations of light, and had slight tremulous motions. A sailor got a blow on the edge of the orbit, from a ramrod, during an engagement, at the place where the frontal nerve passes on the brow. The vision of that eye was instantly destroyed, and when we saw him several years after the accident, the eye remained amaurotic, with a dilated and immoveable pupil: a cataract had formed in the other eye. An officer at the siege of Badajos, received a deep wound on the eye-brow, by a piece of a shell, which, from its direction, must have injured the frontal nerve. Great inflammation and pain succeeded the wound, the vision of the eye became gradually imperfect, and, after a few months, was entirely lost. The pupil was very much dilated and immoveable, and the crystalline lens opaque." (JACOB, p. 66.)

Amaurosis results not only from injury of the supra-orbitar branch of the fifth pair of nerves, but also from lesions of other branches of this nerve. BEER mentions an instance in which it was caused by injury of the infra-orbitar branch; and JACOB witnessed the case of an officer, in whom a ball wounded some branches of the portia dura, in which the injury was followed by amaurosis. Professor GALENZOWSKY has recorded a case in which it resulted from irritation of the superior maxillary branch of the fifth pair. The patient, a man 30 years of age, of good constitution, was suddenly attacked with a violent pain shooting from the left temple. This pain, at first remittent, in about two months suddenly became intense, and the patient found that he could not see with that eye. About a year afterwards, the pain in the eye became so violent that the patient went to Wilna, determined to have the eye extirpated, if no other remedy could be found. Professor GALENZOWSKY found the eye totally insensible to light, with the pupil dilated, and no other visible alteration. The pain, which was

not then so severe, consisted in violent occasional pricking or darting sensations in the left temple and parts around the eye. The first molar tooth of the left side was carious; it had not caused much uneasiness; and the tooth-ache, when it existed, had not coincided with the pains in the temple and eye. The professor determined on removing this tooth, and having done so, was surprised to see a small foreign body at the extremity of the fang. When drawn out, it proved to be a small splinter of wood, about three lines in length, which had probably been introduced in picking the teeth. The pain ceased almost entirely, and on the same evening the eye began to be sensible to light. Vision gradually improved, so that, on the ninth day, the patient could see as well with the left eye as with the right, after a blindness of thirteen months. (*Archiv. Gén.* XXIII. 261.) Mr. Travers has seen an incipient amaurosis distinctly arrested by the extraction of a diseased tooth, when the delay of a similar operation had occasioned gutta serena, on the opposite side, two years before (p. 299); and Richter relates the case of a lady who had been blind for years, but experienced a short recovery of her sight on having a tooth extracted. (*Anfangsgr.* &c. 1. III. kap. 14.) Defective vision frequently attends neuralgia in the vicinity of the eye.

The remedy upon which most reliance is placed for the cure of amaurosis from injury of the frontal nerve, is the division of the nerve. "The only hope of relief," says Mr. Guthrie, "that we are at present acquainted with, lies in a free incision made down to the bone, in the direction of the original wound; and even of the efficacy of this, I am sorry I cannot offer testimony from my own practice, having failed in every case in which I tried it." Mr. Hennen says that he has met with one or two cases of amaurosis from wounds of the supra-orbitary nerve, in which the perfect division of the nerve produced no alleviation of the complaint, but after some time, the eye partially recovered. (*Military Surgery*, p. 350.) We have in several cases had recourse to the moxa,—sometimes unsuccessfully, at others with great advantage. We have now under treatment, a gentleman, who, upwards of a year since, was thrown from his gig, and severely injured. Among other wounds, was one over the eye, caused by that part striking the edge of a cask, against which he was violently thrown. About two months since he applied to the writer, with paralysis of the upper lid and of the abductor muscle of the eye, dilated pupil and imperfect amaurosis. The application of a moxa over the seat of injury produced a decided amendment in the ptosis; and a second application, two weeks subsequently, completely removed this affection and caused a great improvement in the vision of the eye. There still remain paralysis of the abductor muscle and a slight indistinctness of vision, for which we propose to apply a moxa over the mastoid process. Mr. Hey (*Med. Obs. and Inquir.* V. I.) narrates a case of amaurosis following a wound of the frontal nerve, cured by electricity, and it appears to us that it is in such cases most good is to be expected from this remedy.

The mode in which Mr. Hey applied electricity in the above case, was as follows. The patient was first set upon a stool with glass feet, and had sparks drawn from the eyes and parts surrounding the orbits, especially where the superciliary and infra-orbitary branches of the fifth pair of nerves spread themselves. After this operation had been continued half an hour, she was made to receive, for an equal time, slight shocks through the affected parts. In a few days, sight began to return, and in less than three months it was quite restored. Majendie has employed with success in some cases of this form of amaurosis, acupuncturation, with galvanism. He introduced one needle into the frontal nerve, another into the upper maxillary, and brought the needles into repeated contact with the two poles of a voltaic pile. (*Journ. de Phys.* VI. 156.) It is in this form of amaurosis, also, that recourse may be had, with advantage, to the application of small blisters (rather larger than half a dollar) to the head, as employed by Dupuytren. He applies them successively to different parts of the head and forehead, placing on a fresh one as soon as the former has ceased to discharge.

When the fifth pair of nerves are affected within the cranium, in addition to more or less imperfection of vision, there are inflammation of the eye ending in ulceration and opacity of the cornea, insensibility of the conjunctiva and the other parts supplied with common sensation by the fifth pair, with loss of taste in the corresponding side of the tongue. In a case of a young man, an epileptic, recorded by M. Serres (*Anat. Comparée de Cerveau.* II. 67), the ganglion of the fifth pair on the right side was found, on dissection, to be swoln, of a yellow colour, and less vascular than usual; and the nerve where it

seems inserted into the pons Varolii, was changed into a yellow gelatinous substance, like the ganglion, which substance transmitted small processes into the pons, in the direction of the fasciculi of the insertion of the nerve. In this case the right eye, eye-lids, and half of the tongue, had been during life deprived of sensation, while the same parts on the opposite side possessed it perfectly. Little, if anything, is to be expected from medical treatment in such cases.

B. *Amaurosis from affections of the great sympathetic.* In the commencement of this article, we described the connexion existing between the retina, iris, and great sympathetic. This connexion explains the derangement of the functions of the eye which results from some wounds of the neck: may it not also explain the development of amaurosis from gastro-intestinal irritations, in some cases? We have already referred the defect of vision arising from this irritation to the transference of this last to the brain, and that such is generally the case is shown by other symptoms of cerebral affection being usually present; but this is not always the case, and in such instances it is possible that the irritation may be communicated to the retina and iris, by the course indicated, (see Ribes, O. C. 99.).

C. *Amaurosis from an affection of the third pair of nerves.* This pair, as has been proved by Mr. Mayo, is requisite to the motions of the iris, and it is also distributed to the muscles of the globe, except the abductor. The imperfection of vision from lesions of this pair of nerves, is the result of the imperfect action of the pupil and of the inability to direct the eye properly to objects. Little attention has been bestowed upon this form of amaurosis.

D. *Amaurosis from an affection of the sixth pair of nerves.* Mr. Jacob says, that he has seen a well-marked case of amaurosis with distinct and undoubted paralysis of the abductor muscle, disabling the patient from turning the eye outward, and obviously depending upon compression or disease of the sixth pair of nerves (p. 66). We have met with a case of the same kind. The indistinctness or confusion of vision appears to depend upon the loss of parallelism of the eye. Most benefit may be expected in these cases from moxas to the mastoid process, and repeated blisters.

See *Retinitis*, *Hemeralopia*, *Nyctalopia*, *Muscæ Volitantes*, &c. &c.

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I. Hays.

AMBER. (Derived from the *Arabic.*) *Succinum*, Lat.; *Succin*, *Ambre jaune*, *Karabé*, Fr.; *Bernstein*, Germ.; *Ambra*, Ital.; *Sucino*, Span.

Amber is a peculiar fossil resin, of vegetable origin, occurring usually in small, detached, irregularly rounded masses, in tertiary formations in different parts of the world. It is found in France, Switzerland, Sicily, Greenland, and other countries; but most abundantly in Prussia, along the uthern coast of the Baltic Sea, whence the principal part of the amber of commerce is derived. In the United States, it has been discovered at Cape Sable, in Maryland, and in New-Jersey. It is usually associated with lignite and bituminous wood, but occasionally with clay mixed with the debris of trees, probably belonging to the natural order, *coniferæ.*

Properties. Amber is a brittle, inflammable solid, of a vitreous fracture, usually transparent though occasionally opaque, and capable of receiving a fine polish. Its colour is usually different shades of yellow, but sometimes it is reddish-brown, or deep brown. It is tasteless, and, when cold, has no smell, but when heated, it exhales a peculiar aromatic odour. Its density varies from 1.65 to 1.7. Exposed to heat, it melts at the temperature of 548°, with alteration of properties. Subjected to distillation in a retort by means of a gentle heat, it yields first a sour liquor; next an acid sublimate which is deposited in the neck of the retort; afterwards a colourless oil, becoming brown and thick; and, towards the end of the operation, a light yellow sublimate, which collects in the posterior part of the neck. Throughout the whole process, a small portion of inflammable gas is disengaged. The acid sublimate is called *succinic acid*, and exists ready formed in the amber. The sour liquor contains this acid, as well as a small portion of acetic acid. The oil is empyreumatic, and is called *oil of amber*. The yellow sublimate is a kind of *pyretine*, so called by Berzelius; that is, a substance, analogous to resins, obtained from ordinary resins by destructive distillation. It was discovered by Vogel, by whom it was called the *volatile resin of amber.*

Composition. According to Berzelius, amber is a complex substance, containing the following proximate principles:—A volatile oil; two resins, soluble both in alcohol and ether; succinic acid, amounting to $4\frac{1}{2}$ per cent.; and a bituminous substance, which resists the action of all solvents, and constitutes the principal part of the amber. Its ultimate constituents, apart from the ashes, are, according to Drapiez, 7.31 of hydrogen, 80.59 of carbon, and 6.73 of oxygen; and the ashes, amounting to 3.27 per cent., consist of 1.54 of lime, 1.1 of alumina, and 0.63 of silica.

Pharmaceutical uses. Amber is used in pharmacy for the preparation of succinic acid and oil of amber. Succinic acid will be noticed in its alphabetical place, but the oil will be described here.

Oil of amber—*Oleum Succini*—is obtained by distilling powdered amber, (mixed with an equal weight of sand to prevent it swelling too much), with a gradually increasing heat, by means of a sand bath, from a retort into a receiver. The retort is generally directed to be of glass; but as this substance will not bear the requisite degree of heat for obtaining the whole of the oil, it is better to use an iron or porcelain one. The oil comes over together with an acid liquor, on the surface of which it floats, and may be separated by means of a separating funnel. As thus obtained, it is an empyreumatic viscid liquid, of a yellowish-brown colour, and peculiar, characteristic smell. In this state, it is impure, and fit only for external application, and for the preparation of *artificial musk*. For internal employment, it re-

quires to be rectified, when it takes the name of *Oleum Succini Rectificatum.* The rectification is performed by distilling the oil with six times its volume of water, until two-thirds of the water come over. The oil which distils at the same time, and floats on the surface of the water, is then separated, and preserved in well-stopped bottles. In the Swedish Pharmacopœia, it is directed to be purified by a very gentle distillation from wood charcoal, the operation being suspended as soon as the oil comes over coloured.

Rectified oil of amber, when perfectly pure, is colourless, as fluid as alcohol, and of the specific gravity of 0.758. As it usually exists in the shops, however, it has a light yellowish-brown colour. It has a strong, peculiar odour, and a hot acrid taste. It is insoluble in water, soluble to a certain extent in diluted alcohol, and in all proportions in anhydrous alcohol. By exposure to the light, it slowly changes in colour and consistence, and becomes at last black and solid. When dissolved in 24 parts of alcohol of 0.83, and the solution mixed with 96 parts of water of ammonia of 0.916, the oil is disengaged, but held in suspension, so as to form a milky fluid, having a modified odour of ammonia, called *eau de luce*, or *aqua luciæ*, sometimes employed as an excitant in fainting. (Berzelius.)

Artificial musk (*moschus factitius*) is prepared, according to Berzelius, by adding, drop by drop, three parts of fuming nitric acid to one of unrectified oil of amber. The acid is decomposed, and the oil is converted into an acid resin, which is to be kneaded in pure water until all the excess of acid is removed. The substance which remains is yellowish-brown, viscid, and of a peculiar smell, which recalls the odour of musk. It reddens litmus, and dissolves sparingly in water and more abundantly in alcohol. It consists, according to Setterberg, of three resins, two soluble in boiling oil of turpentine, the third, not. It is used in medicine in the form of a tincture, made by dissolving one part of it in eight parts of alcohol.

Therapeutical Applications of Oil of Amber. In a rectified state, it is esteemed stimulant and antispasmodic. Accordingly it has been employed with advantage in various spasmodic affections, such as tetanus, epilepsy, hysteria, whooping-cough, and infantile convulsions. The dose is from five to fifteen drops, given in the form of mixture, prepared with sugar or gum arabic. The unrectified oil is used with advantage as an embrocation to the affected parts in chronic rheumatism and palsy, and to the spine in the convulsions of infants. For the latter purpose, it should be mixed with an equal measure of laudanum, and diluted with three or four parts of olive oil and of brandy.

Franklin Bache.

AMBERGRIS. *Ambregris*, Fr.; *Grauer Amber*, Germ.

This is a solid, opaque, fatty substance, usually of a grayish brown or ash colour, variegated or striated with lighter marks. It is about the consistence of wax, has a less specific gravity than water, and is very inflammable. It possesses a strong odour somewhat resembling that of musk, and a vapid, oleaginous taste. It is insoluble in water, but is dissolved by hot alcohol, ether, and the oils both fixed and volatile. It is by no means homogeneous in its composition, being generally mixed with fragments of fish and sepiæ. From the analysis of Bouillon-Lagrange, it appears that it is composed of adipocire, resin, benzoic acid, and carbon. (*Ann. de Chim.* XLVII. 68.) Pelletier and Caventou, however, consider the adipocire of Lagrange to be a peculiar animal principle analogous to Cholesterine, and which they have termed *Ambreine.* (*Journ. de Pharm.* VI. 49.) But although this substance forms the greatest proportion of ambergris, and has been deemed its essential principle, it appears to be wholly inactive, whilst the virtues of the article reside either in the resin or in an odorous principle distinct from either. There are several varieties of ambergris in commerce, the relative values of which are very different. 1. White ambergris, which is scarce and but of little value, consisting almost wholly of Ambreine, with very little of the odorous principle. 2. Brown ambergris, which has a peculiar unpleasant smell, and is externally smooth, as if covered with a skin. 3. Black ambergris, which, though of a better quality than the two former, is by no means equal to 4, Ash-coloured or true ambergris. It should also be borne in mind, that there are few articles which are so liable to adulteration; much that is met with in commerce being a mixture of various resins and gums. The adulteration can always be detected by the aid of heat, as the true ambergris volatilizes almost entirely, leaving only a trace of carbon, whilst all the adulterations or imitations of it give a more or less voluminous residue of carbonaceous matter.

Ambergris is found on sea coasts, floating on the sea, or in the intestines of the

spermaceti whale. It occurs of various shapes and sizes, in pieces weighing from half an ounce to two hundred pounds. It is chiefly found in the Atlantic ocean, on the coast of Brazil, on those of the islands of the Indian Archipelago, China, &c.; but it would appear that the finest has been obtained on the coast of Madagascar. The most opposite and ridiculous opinions have been promulgated as to the origin of this substance. Thus it has been considered as a species of camphor, a vegetable gum, a marine fungus, a mixture of decomposed wax and honey, an excremential product of certain birds, &c. The first author who attributed it to the whale was MARCO POLO, but the credit of developing its true origin is generally given to Dr. SWEDIAR, who describes it as an intestinal concretion or bezoar formed in the intestines of the spermaceti whale. This opinion is confirmed by the experience of the Nantucket whalemen (*Med. Repos.* 2 hex. I. 417), and is now generally entertained. Before the publication of the memoir of SWEDIAR (*Philos. Trans.* 1783), Dr. BOYLSTON of Boston, and the Hon. PAUL DUDLEY, both stated, in the same work, that it was produced by the whale: they derived their information from old and experienced whale-fishers, who all agreed that it occurred only in the male, and was contained in a cyst. (*Philos. Trans.*, abridged. VII.) Within a few years, VIREY has asserted that it is a kind of adipocire, resulting from the spontaneous decomposition of certain species of sepiæ. (*Journ. de Pharm.* V. 385.) From the circumstance of ambergris almost always containing fragments of the usual food of the whale, and from there being the strongest testimony of its being found in the intestines of these animals, there can be no doubt of the correctness of SWEDIAR's supposition. This fact also controverts the theory of PELLETIER and CAVENTOU, that it is a kind of biliary calculus. Before leaving this subject, it may be mentioned that the information received by BOYLE, from a Dutch merchant, that it is of vegetable origin (*Philos. Trans.*, abrid. III.), is not as devoid of truth as might be supposed, as AUBLET, in his *Histoire de la Guyane*, mentions a vegetable substance produced by a tree in Guyana, which possesses most of the sensible properties of ambergris.

Ambergris at one time enjoyed a high reputation in medicine, as a restorative and antispasmodic. RHAZES thought it was endowed with special action on the heart; RIVERIUS recommends it in atony of the gastric organs; and numerous writers have spoken of it in high terms in the treatment of the Neuroses. The older Pharmacopœias contain numerous formulæ for its administration. At the present time it is seldom employed as a medicinal agent, especially in this country; though, from the concurrent testimony of numbers of eminent practitioners as to its powers, it has perhaps been too much neglected in favour of articles of less value. It is now chiefly used as an ingredient in perfumes and other articles for the toilet.

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R. E. GRIFFITH.

AMBLYAPHIA. (From αμβλυς, dull.) Insensibility of touch or general feeling. (See *Paralysis.*) I. H.

AMBLYOPIA. (From αμβλυς, dull, and οψις, sight.) Αμβλυωπια, Gr.; *Hebetudo visus*, Lat. Dullness of sight. HIPPOCRATES appears to have employed this word to signify the dimness of vision to which old people are subject. (*Aphor.* XXXI. Sect. 3.) Some writers extend its signification to all the forms of dimness of sight, unattended with opacity in the transparent tissues of the eye; thus making it a generic term including several species, as far-sightedness, near-sightedness, imperfect amaurosis, &c. By most modern writers, however, its meaning is restricted to the imperfection of vision arising from impairment of the nervous apparatus of this function. (See *Amaurosis.*) I. H.

AMBULANCE. (From *ambulare*, to walk.) A term of military surgery, and meaning, in its entire signification, a movable hospital or place of succour for the wounded, formed for the occasion, on a field of battle.

Where large bodies of men are en-

gaged in warfare, one or more establishments of this kind ought to be attached to every division of an army, as a part of its staff or general service, and follow all its movements. All orders touching its duties should emanate from head quarters, except in some instances of special service; its equipment ought therefore to be kept entirely distinct from the medical service of regiments, but so arranged as to be made auxiliary to the latter on any occasion requiring it.

A properly organized ambulance must present the features of a hospital, but unencumbered with heavy articles. As its duties last only for short periods on any particular occasion, as it establishes itself at a given point to wait the result of an action, attends for the time to the wounded, dismisses them to the next stationary hospital, and is off again immediately to follow the motion of head quarters, so it is necessary that every article not absolutely wanted, be omitted in its equipment, with the view of leaving its movements as light and easy as possible.

The intention of an ambulance is to afford to the wounded a prompt and easy transportation from the ranks while in combat, to concentrate a body of medical men upon any particular point or points of an extended line of battle, and to transport along with them their instruments, medicines, and nurses. This arrangement has a beneficial effect upon the minds of soldiers, in affording to them the certainty that wherever they may be wounded, efficient assistance is at hand; also, in slight wounds many may return again to the ranks on being dressed,—besides which, it prevents those desertions from the line, professedly under the show of bearing off a wounded comrade, and which every man who has been engaged in an active campaign knows to weaken a force very much, when an action is protracted and severe. Humanity, and the efficiency of the service, therefore require that every numerous body of soldiers should have its flying hospital or ambulance.

In the wars of a former period, the appointments of hospitals were so imperfect that the quantity of misery was much increased, and it was frequently necessary to abandon the wounded, or to consign them to the doubtful and unskilful attentions of the inhabitants of the neighbourhood of a field of battle. The greater permanency of military establishments in modern times, and a well-digested system of management, have proved the importance and economy of saving, by all proper assiduities, the lives of the soldiery, as great expense is avoided in enlistments, and skilful inured veterans are preserved for the line of an army, instead of uneducated recruits, who, from the novelty of the exposure and mode of life incident to military affairs, more readily become sick and unfit for duty. This innovation in the cause of humanity is traced by the French writers, to Henry IV., king of France and Navarre; indications of it may, however, be found in the ninth century, under the emperor Leo VI., who made war upon the Hungarians, Bulgarians, and Saracens.

The following are the leading considerations in the establishment of an ambulance: The officering or personal—the material or mechanical part—and its duties.

It is recommended that an army, in taking the field, be provided with everything necessary to the wants of the sick; as much disappointment is said to arise, even in Europe, from a dependence upon requisitions. It should therefore be calculated that in any given body of men, one fourth or a fifth at least will in a campaign have to pass through the hospitals, in consequence of wounds and accidents. To which we should also add, that if success follow the movements of an army, many wounded of the enemy must be treated, and both humanity and magnanimity require that there should be no distinction between our own wounded, and prisoners of war in that condition, but that the kindest offices be extended with an equal hand to both. Recollections of this kind, emanating from such circumstances, are frequently the most precious of a soldier's life, and the feelings which they generate serve much to diminish the ferocity of war. In an active campaign, and with a small body of troops, the estimate of one fourth for wounded will probably be found rather low. In the campaign of 1814, for example, on the Niagara frontier, in which the writer participated as Hospital Surgeon's Mate, and where about three thousand regular soldiers opened and conducted the operations, with but very few recruits during the summer, his opinion, from a general recollection founded upon nearly the whole of the wounded having either reported at or passed through the hospital at Buffalo, which was for the most of the time under his charge, is that one half of the whole number, or fifteen hundred at least, must have suffered from wounds of various intensities. It is, however, difficult to obtain perfect accuracy except where tabular statements are kept, and as he has not preserved copies of re-

ports to head quarters, reliance must be placed upon the uncertain deductions of general reminiscence.

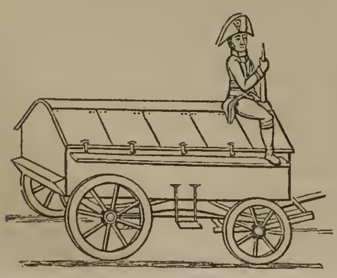
The following calculations are founded upon the presumption of fifteen hundred men being wounded, which in European service would accrue to a body of six or seven thousand troops, and in our own, perhaps to a smaller number. We would also admit three general engagements, each productive of five hundred wounded, so as to make, in the whole campaign, fifteen hundred men to be attended to.

1. *In regard to the personal or officering.* There should be a chief surgeon—two junior surgeons—and six assistant surgeons: a quarter-master—a steward—and fifty nurses, one to every ten men. The present practice of the French army is to enlist the latter for the specific duty, which has the advantage of securing experienced attendants, and of preventing companies from being broken up by a detail upon them for hospital duty, or by retaining their men in hospital for this purpose, which is a frequent cause of dispute between hospital surgeons and the officers of the line. There ought also to be a number of females for washing and cooking, but they will come in of course with their wounded husbands, so that it is unnecessary to make regular enlistments of them.

An experienced cutler, to keep instruments in order, ought to be attached to the ambulance.

All the medical officers should be mounted, and a few extra horses for expresses allowed.

2. *In regard to the material or equipment.* There should be two carriages for the conveyance of instruments and hospital stores. The best form of them is that of a long box with a hip roof cushioned on the ridge, so that it may be occupied as seats. The box should be divided into two rows of compartments, each side having a lid moving on hinges. (See accompanying figure.) All the articles ought to be properly classified and put away in these compartments in such manner that they can be readily got at. Several complete sets of instruments, all the varieties of surgical dressings, including splints and bandages, medicines, camphorated spirits and brandy, ought to be on the list.



There should be four carriages hung low on springs, each one being seven feet long by four wide: to the sides may be appended moveable seats, somewhat like those of the Irish jaunting car. They should have good thick mattresses at the bottom. The object of these carriages is to receive the wounded; the worst cases may be laid on the bottom, and a file of slighter wounded be placed on each side. (See accompanying figure.) These carriages traverse the field of battle, and pick up the soldiers wherever they may be found.

Several litters should also be kept, to be carried by the hand; two long poles connected by a blanket answer the purpose. Baron Percy has, with the same view, invented what he calls a Brancardier, a kind of hand-barrow, which may be taken to pieces at pleasure, and which must answer the purpose remarkably well.

3. *The position of the Ambulance.* When an action begins, the ambulance should be placed in the rear of the line, at a sufficient distance from the range of cannon-shot. Adjoining houses ought to be put in requisition, and if there be not enough of them, hospital tents should be erected, and an abundance of straw or hay for bedding got ready. In the French service, an order from head quarters commonly defines the position of the ambulance, which should be regulated by a sufficient propinquity to the field of action—by its being on elevated ground—and near a supply of water.

These dispositions being made, one portion of the corps should remain on the spot, to attend to the wounded who arrive; another ought to be as near as possible to the seat of action, with their carriages, to attend to the wounded who retire from the line, and they should be well furnished

with all the apparatus for stopping hemorrhage immediately, and should join in, as occasion may require, with the surgeons of the line. The action being over, and all the wounded assembled in the ambulance, the medical force concentrates itself on it, and then completes those operations which the hurry of their engagements may have suspended for the time.

At as early a period as practicable, a classification of the wounded should be made—the lightest cases sent back to their regiments—the next in grade requiring some time for their recovery, detached to the nearest stationary hospital, and the worst cases retained. The usages of civilized warfare do not permit any interruption to them, even in case of the opposite party proving victorious; on the contrary, it is incumbent on the victors to add, by every means in their power, to their comfort.

The surgeons who have most distinguished themselves in this department of military surgery are Larrey and Percy, both of whom have contributed much to its perfection. The specification of each instrument, and of the apparatus in use, would be a catalogue of a Surgical Armamentarium, which any well-educated man can make out, the items of which are, however, too numerous for present insertion.

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W. E. Horner.

AMENORRHŒA. (From α priv., μηv, a month, and ρεω, I flow.) The broad sense in which the term Amenorrhœa is frequently employed, though too comprehensive for practical purposes, seems to be justified by its etymology. Thus it is made to signify, first, the failure of the menstrual action, at the period of life at which it is usual for it to appear. Second, the default of this action, after that discharge has been commenced, and for a longer or shorter time persisted in; and this suspension owing to the influence of any adequate cause, with the exception of pregnancy, and suckling. Third, mechanical or physical obstructions; as an imperforate hymen. Fourth, an impervious os uteri. Fifth, its final cessation, at a remote period of female life. Sixth, the stoppage of this discharge, during the continuance of some remote chronic affection; as phthisis pulmonalis, or other chronic diseases.

Now, between the first and second, and between the third, fourth, fifth, and sixth, of these conditions, there cannot exist the slightest analogy, either anatomically, or pathologically. In the first, the defect almost always arises from the imperfect development of the organs on which the menstrual discharge depends; namely, the uterus and ovaries. In the second, this defect in development does not exist, as is evident, since this fluid has been produced, but its farther secretion is interrupted by certain remote causes, to be named presently. The third and fourth consist of merely mechanical interruptions, and are to be relieved by mechanical means, alone. The fifth consists in a defect of power in the parts that were wont to produce the menstrual fluid at the earlier part of life, agreeably to the order of nature, though neither the eye nor the knife may be able to discover, or trace, any anatomical change in either the ovaries or the secreting surface of the uterus itself. Consequently, in the first, second, third, and fourth, we may have every rational hope, that by proper treatment, the defects may be removed and the function restored; while in the fifth, it would be at least preposterous, if not injurious, to attempt the restoration of the lost power of the uterus and ovaries by constitutional treatment. In the sixth, the same want of analogy exists; especially with the first, and second; for in the symptomatic amenorrhœa, the secreting surface of the uterus is engaged in the formation of a new production, namely, tubercles, or profuse secretion. We shall therefore limit the term Amenorrhœa to three conditions of the uterus; 1. where the uterus is tardy in taking on the process of menstruous secretion; 2. where this secretion is interrupted by some idiopathic morbid cause; 3. where these causes act indirectly.

In our account of this affection, we shall confine ourselves to the first, second, and sixth conditions enumerated above; and give to the third, fourth, and fifth, separate considerations. (See *Hymen, imperforate; Os Uteri, impervious; Menses, final cessation of.*) For it will be found that by giving each of these subjects an

independent situation, practical views can be more fully and efficiently explained.

Pathology. As we are altogether ignorant of the efficient cause of menstruation, we cannot pretend at the present time to ascertain, either the anatomical or physiological condition of the uterus and its dependencies, in amenorrhœa, unless it be merely the degree of development it may have enjoyed. It is true that MORGAGNI mentions a certain state of engorgement in the uteri of women who had died, according to his statement, either just before, during, or immediately after this process—but a mere state of congestion will not lead us to any certainty respecting the efficient cause of menstruation, a congestive condition of the uterus being seen in several of its affections, without menstruation being one of their attendants. Something more is then required, than the mere fullness of the vessels of that organ; but what that something is, we may conjecture, though we cannot prove—much must, consequently, be taken for granted, if we pursue an hypothesis.

All we do know, is, that a certain condition of the uterus and its appendages is absolutely necessary for the secretion of the menstruous fluid; and that it requires a normal state of both, to produce it, under certain conditions of these organs, at the proper period, and when the female is neither pregnant nor suckling, nor passed the menstrual period of life. But when the uterus ceases to secrete the menses from an idiopathic morbid cause, we are at a loss to say in what the pathological change consists; for, so far as we know, death has never taken place from the mere absence of the catamenial discharge; or without other lesions being produced, which may again indirectly act upon this organ, so as to change a present, or produce, a new pathological condition. We must therefore wait for further observation, before we can establish the pathology of the uterus, in the species of amenorrhœa under consideration.

Division of Amenorrhœa. We shall consider Amenorrhœa under the following heads.

1. The tardy appearance of the menses —or the retention of the menses—the "*emansio mensium*" of authors.

2. Where this secretion is interrupted after it has taken place for a longer or shorter time, by other causes than pregnancy or suckling, but which causes produce an idiopathic affection of the secreting portion of the uterus.

3. Where this evacuation is indirectly arrested, by the influence of certain chronic affections of other viscera.

§ 1. *Of the tardy appearance of the menses; or the retention of the menses*, the "*emansio mensium*," of authors. The term "*emansio mensium*" of systematic writers, is by no means well adapted to explain the condition of the female previously to the first eruption of the menses. It conveys the idea that the flow is prevented by some mechanical cause—a circumstance altogether at variance with the fact; for that which is not formed, cannot be retained; yet, we shall be compelled to employ the term, until one is invented to express the condition of a part, or a gland, previously to that degree of development which will enable it to perform its ultimate offices. The uterus may therefore be considered, at this time, to lack the power to secrete the menstrual fluid, rather than to have that power suspended or destroyed.

In a practical point of view, this distinction should not be lost sight of; for there is a great difference between the *want* of a capacity, and the *suspension* of one; and on this distinction in the present instance, much will depend, in the management of the two cases—in the first instance, it may very often be proper only to temporize; while the other will require many times, a well adjusted and active treatment.

Nature appears to have had an important design in the establishment of the menstrual discharge in the human female —for its abnormal absence, whether original or accidental, is always attended by barrenness. A similar importance appears to be attached to the occasional discharge from the vagina of every quadruped, and perhaps extends even to the whole of the Mammalia; for though the discharge in the latter is not strictly menstrual, with very many animals, it nevertheless appears to be a sign of as much certainty of the capacity of the uterus to become impregnated, as it does with the human female, who menstruates—and, without a normal condition of this discharge, neither becomes impregnated, even under, in other respects, the most favourable circumstances. We must not then wilfully shut our eyes against the obvious import of this discharge; especially in the human female—namely, it being a declaration of the condition of the uterus to become impregnated, and its capacity to foster and protect the product of such impregnation. This arrangement in the inferior animals has a like identity of object.

The only remarkable difference between the discharge in question, in the inferior animals that possess it, and in the human female, is, that in the former it never appears but at the period of calescence and desire; while in the latter, a state of venereal excitement is not necessarily an attendant upon the flow of the catamenia. In this, as in everything else of God's providence, we see nothing but marks of infinite wisdom and consideration; for, to what disgusting scenes should we be subjected, were the inferior animals not controlled by this periodicity; and how much would mankind suffer, as social beings, were the female influenced by other than the existing laws that govern the instinct of procreation!

In descanting on the capacity to produce the menstrual discharge—the laws which govern it—together with its final cause, fancy has but too often taken precedence of reason, and fable usurped the place of sober facts. What can be more preposterously fanciful than the opinions of Pliny, and of many later writers whom we shall not stop to name, respecting the acrid qualities and baneful influence of this discharge; notions in support of which not a single fact can be adduced calculated even to excite suspicion. The discharge is in fact no less innocuous, than important, to the female economy.

Whatever other opinions and speculations the inveterate theorist may indulge in, the following facts with regard to the menstrual discharge, cannot be controverted, though they may give rise to discrepant deductions.

First; that this discharge never appears as the fulfilment of one of the laws of the system, but at a comparatively advanced period of female life.

Second; that when it does appear as a normal product of the uterus, it marks, with great certainty, the capacity of this organ to become impregnated—this marks, or constitutes, the period of puberty.

Third; that this great object, namely, procreation, is seldom, or perhaps never attained, but when the catamenia are in a completely normal state.

Fourth; that this function continues, during the most befitting period of female life, for the objects for which it is instituted; and it is the sign of her aptness to become impregnated.

Fifth; that after this period has elapsed, this discharge ceases altogether; or, if it continue, from some change in either the ovaries or uterus, or both, it becomes no longer a certain sign of the capacity just spoken of.

Sixth; that after the final cessation of the menses, the ovaries cease to furnish ova fitted for impregnation, or the uterus ceases to cherish them, if they have been impregnated—therefore, the menses when healthy, are, up to this period, the sign at least, of the capacity of the female to become fecund; and without this condition, she ever remains barren. Farther, that this discharge is the sine qua non to impregnation, as this never takes place before the secretion of the menstrual fluid, nor after it has ceased to be formed. We disbelieve those instances purporting to contradict this belief. (See "*Diseases of Females*," by the author of this paper. Art. *History of Menstruation.*)

From what has been said, it must be evident that the menses never appear (nay, cannot, in their best manner,) until the uterine system has arrived at its full development. That this takes place at different periods of the life of females, living under considerably different temperatures —heat advancing, and cold retarding, this sign of puberty. That the period of puberty *must arrive* before the uterus furnishes the menstrual fluid; but that this period, even under the same latitudes, may be sooner or later; owing to the influence of certain physical causes out of, or to certain physiological ones within, the body—either, or both, tending to hasten or retard uterine development, according to the nature of these causes. Thus, all modes of life which have a tendency to increase the uterine circulation, will hasten its development.

Among the most powerful and certain of these causes, are climate and modes of life—but it is not our intention to attempt an explanation of their modes of action, in this place; it is sufficient for every practical purpose, that we induce a belief in their agency, as this admission leads to the successful treatment of the "tardy appearance of the menses."

The period of life at which the menses appear, be this sooner or later, is denominated "*puberty*;" because the female at this period (cæteris paribus) is, as we have just stated, capable of impregnation, and of supporting its ordinary consequences; and not before. This period is not invariable, as we have already said; being much earlier in hot climates, than in cold. In Asia, Africa, and South America, it is not unusual, as we are informed by much concurrent testimony, for this discharge

to make its first appearance, even at eight, but often at nine, and very constantly at ten—while in Lapland, and other arctic positions, it does not take place until eighteen or nineteen.

This statement of the influence of climate upon the female system, has been universally conceded; all travellers confirm it; and all physiologists admit it, even up to the present time. We are therefore not a little surprised to find this general belief disputed by Mr. ROBERTSON. (*Edin. Med. and Surg. Journ.* for Oct. 1833.). "This opinion," he remarks, "which is general, appears to be erroneous; and this doctrine naturally suggests questions, the solution of which they have not, so far as I know, attempted. It might be asked, for example, whether in countries where the *catamenia* flow, as they allege, at the age of nine years, this sexual precocity is manifested by the mind, equally as by the body? or whether the mind remains till a later period, infantine? or whether the female, in all her faculties, mental and bodily, exhibits this early development?" Now, MONTESQUIEU has, by Mr. ROBERTON's own showing, answered this question, by declaring that the mind is not developed in equal proportion; and on this fact he builds an argument in favour of polygamy. And Professor FERGUSON declares, that in the East, women become slaves, because their minds are not sufficiently developed to bear up against the encroachments of man, at the moment of their greatest, but evanescent beauty; for then they become the objects of the most ardent love.

But it is not necessary to our present object, to inquire into either the civil or political consequences of this early menstruation; it is sufficient that we establish the fact, that climates of different degrees of temperature, have a marked influence upon both animal and vegetable life; and that upon the human female, especially, this influence appears to be abundantly manifested by the different periods at which puberty arrives; and withal, when this period does arrive, the female is capable of fecundation, and of overcoming all its ordinary penalties; for it cannot be supposed that the Deity would be so idly capricious as to impose this condition, without guarding the female, at the same time, against any unusual risk consequent upon that condition.

We know from our own proper experience, that in proportion as we advance south, the period of puberty becomes earlier: a Mexican lady, on whom we are now in attendance, assures us that she was married before she was twelve, and was a mother before she was thirteen. Nor is this an extreme case; the same lady informs us that menstruation generally takes place very early, and that many are mothers by the time they are thirteen. In our climate (40° N. lat.) the general period of menstruation is from fourteen to sixteen—in this, however, as in every climate, there may be exceptions—but they are only exceptions to the general rule, and must not be taken for the rule itself, as Mr. R. appears inclined to do: since he "entertains a doubt, whether the period of puberty is nearly so *uniform* as we are taught in books to consider it;" because he had met with a few exceptions to the usual law of nature in regard to this period. But unfortunately for this gentleman's thesis, he has given a table purporting to be correct, of the answers of 450 women, to the interrogatory, "at what period did you first menstruate?" which proves that at the periods of 14 and 15, more than double the number were found to have menstruated, than at 10, 12, or 13 collectively; and nearly one third more than at 16, 17, and 18 collectively; and nearly seven times more than from 19 to 20. And what is truly remarkable, is, that there were fewer at 16 than at 15 or 14; though we have chosen to extend the range from 14 to 16.

Is it not then evident, that from 14 to 15 is the most constant period of puberty in the latitude of Manchester (England), where the observations were made? We have already stated, that in our latitude (40° N.), this rule obtains very uniformly; but Mr. R. has given our location a much broader range than he should have done, when he did us the honor to quote from us upon this subject; by saying that our observations were made in "North America;" an extent of country that embraces almost every climate on the face of the earth—extending from 72° north latitude, to 70° 30′ south latitude; that is, 64½ degrees, or 3870 geographical miles; or 4500 British miles.

We might readily extend our remarks upon Mr. R's observations; but we have said enough to prove, first, that there is a fixed general period of puberty in every remarkable difference of latitude; and second, that in this, and nearly similar latitudes, this period is from the 14th to the 16th year.

It is a little remarkable that Mr. R. should adopt, for the support of his hypo-

thesis, the exceptions to a rule, rather than the rule itself—thus he thinks his reasoning strengthened by a case related by Mr. Thorpe, of a girl of eleven years of age, who became pregnant, and was safely delivered, without unusual difficulty, of a full-grown child. But we are at a loss to perceive the value of this case to the point at issue; it only goes to confirm the correctness of our definition of the term *puberty*, and not the uncertainty of this period in respective latitudes. This case is one of the exceptions to the general rule, as is proved by the table furnished by Mr. R. himself, from which it appears that there were but 10 cases of menstruation, at the age of eleven years. But this case proves that in even precocious healthy menstruation, impregnation may take place after the same manner as where the period of eleven years marks the ordinary arrival of puberty—or of menstruation; for in the case referred to, Mr. R. admits that this process had preceded pregnancy.

But we shall urge nothing further in support of the position we have assumed, namely, that each remarkable difference in latitude or climate has its own epoch for the arrival of puberty—and that the knowledge of this particular fact is of the first importance towards the successful treatment of tardy menstruation. Indeed, if this circumstance be not constantly kept in mind, the management of such cases will always be uncertain and empirical, and very often highly dangerous. We have seen the worst consequence follow the ill-timed administration of emmenagogue remedies; nor can this create surprise, when highly stimulating medicines are addressed to the uterus with the intention of forcing it to the exercise of a function that it is incapable of performing; its organization not being sufficiently developed for it to take on the process of menstrual secretion.

Causes of the tardy appearance of the menses. We have stated above, that for the production of the menses it is absolutely necessary that the uterine system be completely developed; since no organ can successfully perform its ultimate function, unless that organ be perfect, or nearly so, in its arrangement. It will therefore follow from this corollary, that whatever may interfere with the regular development of the uterus and its appendages, will prevent the secretion of the menstrual fluid, properly so called: such causes may be, temperament, leucorrhœa, imperfect development, anemia, cold, passions or emotions of the mind, chronic affections, &c. &c.

A. *Temperament.* It is said that this influences the development of the body; and that the *lymphatic* is more liable to this interruption, than any other; and our own observations incline us to believe the imputation to be just. For in this temperament the circulation is languid, slow, and feeble; the muscular system is soft, yielding, and without much force; and this observation extends even to the heart and blood-vessels. The absorbent system acts feebly, and permits the formation of a larger quantity of fluids than the due proportion for the solids; hence, the serous infiltrations into the cellular tissue, which give character to this temperament, together with a pale or cadaverous skin; the latter also showing the languid state of the circulation. Even the brain appears to participate in this general want of energy, as the subject of it is averse to both mental and bodily exertion; consequently, the uterine system will be tardy in its development, as, for the most part, it is the last to be perfected, its functions not being called into requisition until the female is considerably advanced in life, or until its duties can be available—for, as a general rule, development takes place in the order of necessity for such development. But let it be remarked, that there is no one of the temperaments that may not have, occasionally, from some cause or other, a tardy or feeble development to attend it. We are sure we have seen the menses tardy in the sanguineous, and also in the nervous; at least as far as definition will characterize these several conditions of the human system.

Nor is it absolutely necessary that every other system of the body should fail in normal development, to implicate the uterine; the reverse of this is sometimes the case; and among such are some of the most obstinate, and uncertain to be relieved. Thus we see females have their osseous system early and rapidly expanded, but accompanied by a flaccid, feeble, and ill-developed muscular system. The girl is then said to be large, or tall, for her age; she is weak, readily fatigued, and the heart and blood-vessels easily excited to increased action; the chest is flat; the shoulders round; the scapulæ prominent; the neck long; the face pale, and frequently bloated, especially in the morning; the mammæ undeveloped; the pubes not supplied with hair; the pulse frequent and small; hands and feet cold, and disposed

to be damp; the appetite craving improper or indigestible things, &c. In a word, the girl has the appearance of more years than have actually passed. There are cases of sudden and anormal partial development, or aberrations of nutrition, which are sure to be attended by general debility, and thus interrupting the expansion of the uterine system.

B. *Leucorrhœa.* This debilitating discharge is an almost constant attendant upon this peculiarity of system, and not unfrequently becomes an efficient cause of the non-appearance of the menses, by preventing the healthy and essential congestion from taking place in the uterus itself; and to such a mischievous length does this discharge extend sometimes, as to cause that peculiar state of the system called *Chlorosis.* Some have considered chlorosis as a cause of the tardy appearance of the menses; whereas it is only the product of leucorrhœa, combined with amenorrhœa, of which it is sometimes the active cause.

C. *Imperfect development.* In some cases, a partial cause, arising from an anormal condition of the uterine system, may give rise to the non-appearance of the menses; thus, either the ovaries or the uterus may be but partially or imperfectly developed, either condition of which will with great certainty be the cause of this amenorrhœa. Of both of these conditions, Morgagni and others give examples; and two have been observed by ourselves.

D. *Anemia.* This may also produce the same consequences. Anemia may be in these cases, general or partial, either of which will produce the same effect. In all cases of this kind, whether general or partial, the arterial calibre is reduced; and this in proportion to the degree of the anemia. If general anemia prevail at a period of life at which development is progressing, it will necessarily be suspended in every portion of the body. But if it be partial, some one particular organ may suffer from the want of the quantity of blood necessary to its development. And as the uterine system is the last to be unfolded, it may, and most probably does, suffer oftener, more extensively, and more certainly, than any other organ, if anemia occur about the period of puberty.

We have just stated that Morgagni and others have furnished instances of extremely small or undeveloped uteri and ovaries. Now, this failure of nutrition may arise from some deficiency in anatomical arrangement, or from a want of determination of blood to these organs. If it be from some anatomical imperfection, the structure may be such as to prevent these organs from profiting by the natural tendency to plethora or congestion at the pubescent period of life. Or if it be from the want of determination of blood to these parts, it is probably owing to strong determinations to other parts; and hence the rapid and precocious developments of other portions of the body—and hence the common expression, that "growth has exceeded strength." Either of these conditions may become a cause of the tardy appearance of the catamenia; or in some cases, of the entire absence of the menstrual discharge, during the whole life of the female. The same may be said of some of the viscera, when in a state of congestion; as, the liver, spleen, lungs, stomach, or brain. Thus, girls are found to menstruate later, who live in marshy countries, where intermittents are common, than those who dwell in elevated, dry situations; though there may be in the latter, an extension of the general frame. This is most probably owing to the tendency of this species of fever to produce congestion in the liver or spleen, which diverts the natural current of blood from the uterus, at a period when, for the purposes of the system, this organ should have a more than ordinary flow to it—thus the *engorgement* of one organ may produce anemia in another.

The same may be said of that *hyperemia* of the lungs, which ends in hemorrhage from these organs; especially when this is so often repeated at a period so near, or even at puberty, as to prevent the appearance of the menses. In these cases, the lungs are said to perform a vicarious office with the uterus—but this is no otherwise so, than with the liver or spleen, as just stated above; for though the discharge of blood from the lungs may become periodical, and the period of return be monthly, it must not be looked upon as a compensating discharge, or to have been instituted in lieu of the menses, notwithstanding it may interrupt their appearance at the expected or proper time. The same may be said of the stomach, when hematemesis is produced; or of the brain, when determination to it is strongly marked, especially when it is followed by epistaxis.

It has been remarked by several pathological writers, but especially Andral, that the activity of the secretions of several of the tissues, as, the serous, mucous, and cutaneous, furnish a very disproportionate quantity of fluid, when compared with the quantity of red blood that is transmitted to

them. In proof of this, we need only call to mind, abdominal dropsy; the watery discharges from the bowels, in cholera; and the colliquative sweats, in phthisis pulmonalis. So the uterus, when in a state of anemia, may furnish an unnatural quantity of fluid; as in leucorrhœa, either purulent or serous, and thus perpetuate the exhausted state of this organ. Now, in this bloodless state of the uterus, it cannot derive a sufficient quantity of nutritive fluid, for its development—or, if it do, a great proportion is immediately carried off, by the inordinate secretions of its internal membrane. Thus it becomes evident, that anemia will be a powerful cause of amenorrhœa; and that it produces this state of the uterus, in one of two ways—first, by preventing development, and second, by interrupting that degree of congestion in this organ which is essential to the menstrual function. In either of these cases, there may be present, either a general or a local anemia, and as this condition may influence our therapeutical views, it should always be kept in mind. In general anemia, there may not be the slightest evidence of uterine development; or there may be a partial display of it. In the first, there will be the entire absence of the sympathetic developments; in the second, there may be slight swellings of the mammæ, and a sparse protrusion of capilli upon the pubes. The first may also be known by there being no vaginal discharge; while in the second, this may be moderate or profuse. The degree of development being, in some measure, determined by the quantity of this discharge; and as a general rule, the first will be less certainly manageable (cæteris paribus), than the second; for in the first, we must not only relieve the state of anemia, but wait for the proper degree of development of the uterus after the system has been furnished with a greater quantity of blood, and that of better quality; while in the second, the menstrual secretion may take place, after anemia is relieved, by merely directing our views to the leucorrhœal state of the uterus and vagina; for this discharge is always unfavourable to the first eruption of the menses, by acting as a topical depletion, (though it manifest a better general condition of the uterus;) and thus preventing or removing the menstruous congestion. Of this, however, we shall have occasion to speak again.

E. *Cold*, either generally or partially applied, may, if excessive, or if operative at the moment the menstrual congestion is forming in the uterus, be the cause of the tardy appearance of the menses, by removing this condition; which, as we have said before, is essential to the formation of the menstruous blood. When this state of the uterus is thus suddenly removed, some one of the other viscera will become engorged, and hemorrhage may ensue.

Of this we have seen a striking case very lately; in a small, but well-developed girl, rather under fourteen, who had all the premonitory symptoms of the menstrual eruption—as slight fever, head-ache, pain in the hips and loins, slight uncoloured discharge from the vagina, soreness and distension of the mammæ. On an occasion she was sent some distance, in a severe, cold rain, without proper protection, especially of her feet. She returned very cold and wet; and before she could be made comfortable, she was seized with a vomiting of blood, to a considerable extent. It was, however, finally arrested by mustard pediluvia, as warm as could be borne; sinapisms over the whole abdomen—that is, from the sternum to the pubes, until considerable irritation was produced on the skin; together with an enema of a saturated solution of common salt and warm water. Whether nature will make another effort to produce the catamenia at the proper time, we cannot say, as the proximate period has not yet arrived. We have put her upon the use of the Tinct. Lyttæ, in hopes it may aid nature in her effort.

This cause (cold) is more mischievous, at the period of female life that we are now considering, than is generally admitted, principally owing to the reprehensible state of ignorance in which the girl is kept by an over-fastidious mother. This ill-timed delicacy cannot be too much reprehended—for we hold it to be the bounden duty of every mother to instruct her daughters on a subject that so vitally affects their comfort; or perhaps their lives; we have seen too much evil arise from this omission, to pass over in silence, this neglect of duty.

The ill-timed use of the cold bath is very frequently and justly chargeable with interrupting the menstruous secretion at the moment it was about to make its appearance—therefore, this remedy or luxury should be prohibited at the approach of puberty; or it should be very rarely and cautiously indulged in.

F. *Passions or emotions of the mind*, &c. These affections of the sensorium certainly have a control over the uterine functions; but their power, in our estimation, is very limited in the species of amenor-

rhœa now under consideration. For they cannot well exist sufficiently long to interrupt uterine development; and without they do this, it will be difficult to understand how they can prevent the secretion of the menstrual fluid, if the uterus be properly prepared for this office; as the tendency of these causes is to hurry the general circulation, and sometimes to produce such strong local determinations as would seem rather (à priori) to be favourable than unfriendly, at certain moments, to the appearance of the menses. Terror has sometimes accomplished, in a moment, that which long medical discipline had failed to effect. Of this, a remarkable instance fell under our notice many years ago. A young lady, between fifteen and sixteen, apparently pretty well developed, had become chlorotic, notwithstanding she had the best advice the city could afford. She was reduced to great feebleness; and a number of alarming symptoms were present—as cough, indigestion, swelling of the feet and ankles, leucorrhœa to a great extent, &c. She was recommended, as a dernier resource, to try sea-bathing. She accordingly went to the sea shore for this purpose. The third day after her arrival at a bathing-place, and before she went into the surf, she was tempted by the inviting appearance of a tree of apples to enter the orchard to procure some of the fruit. They were, however, beyond her reach; and to secure some, she lifted up a piece of a rail to strike the distant fruit—to her extreme terror, a snake was observed to lie immediately under it. She threw down the piece of rail, and fled as fast and as far as her weakness would permit; she fainted and fell—but upon recovering from this state of exhaustion, she found herself in the situation she had so long and anxiously desired. From this moment, her health improved, and was, in the course of a short time, entirely restored.

It is true, that *grief* may continue to suspend the menstruous secretion, where, from the degree of development, the uterus had given every promise for the performance of this function. But in such cases, the interruption will be but temporary, if there be a suspension of the remote cause. Of this, we have seen several examples. On the other hand, however, if this affliction of mind occur before such a degree of development had taken place as would justify the expectation that menstruation was about to ensue, it will with great certainty, if the grief be profound, suspend its farther progress. Of this we have also seen instances.

It would seem from these facts, that moral causes may, from the difference of their nature, have very opposite effects upon the uterine system at a period approaching puberty, or when it has absolutely arrived, (save that the menstrual action had not commenced,) or at a period more remote. That on the one hand, some of them, such, for instance, as by their operation shall increase or will hasten the circulation and the more general distribution of the blood, will not operate in an unfriendly manner in all instances—while others, by their contrary tendency, will suspend, and sometimes for a long time interrupt, uterine development, and thus produce all the evils such suspension can create.

G. *Chronic Affections.* These causes are by no means uncommon, and are almost always irremediable, because the diseases which have suspended the natural functions of the uterus, as phthisis pulmonalis; chronic affections of the liver, spleen, pancreas, stomach, and intestines, are in themselves incurable. Such instances of retarded menstruation as have either of these diseases for their cause, can only be remedied by the removal of these causes; and therefore should not be specifically prescribed for, however strongly we may be urged by the anxious friends of the unfortunate patient. It is the common belief of every body out of the profession, and we may safely add, of but too many in, that the suspended function of the uterus is the cause, instead of the effect, of the chronic affection; and in consequence of this belief they importunately urge compliance with this assumption—but let us beware how we adopt this opinion; as we may hasten to a fatal issue, a disease that might, by proper management, have been kept a long time at bay. For the proper management of such cases, see the diseases above enumerated, *Phthisis*, &c. But chronic affections much more rarely produce mischief in this species of amenorrhœa, than in the one next to be considered, namely, where the catamenia have been interrupted by some immediate cause, as in idiopathic amenorrhœa, (q. v.).

Diagnosis. It is thought to be very difficult by some, to distinguish between these two states—that is, which is the cause, and which the effect—but if our experience have not misled us, we think the following signs will sufficiently designate them. When a chronic affection is the

primary disease, and is of pretty long standing, and especially if it be incurable in itself, it will be found, though it act slowly upon the uterine system, that it will interrupt both general and local development very soon after it has acquired a threatening aspect. Now the uterus and its appendages being involved in this general consequence, they will not of themselves be unfolded, nor will they give rise to the sympathetic developments which depend upon them; as, the enlargement of the mammæ, the production of hair upon the pubes, &c. Should this happen at a period a little later, that is, after development of the mammæ have commenced, that development will proceed no farther, or will most probably retrograde. But it must be remarked, that in order that these affections may be capable of interrupting or suspending uterine development, they must become chronic, and perhaps uniformly incurable—for in their acute form they have no such tendency. If this be true, and we have no doubt of its being so, the previous history of the case will aid the diagnosis very much, and lead with more certainty to the knowledge of the primary disease.

H. *Idiopathic Amenorrhœa.* If the suspension of the menstrual secretion be the primary affection, it will not produce mischief until after a long time; and, until after uterine development is so complete as to be capable of furnishing the expected discharge, though this is prevented by the operation of some remote cause, as the sudden or long-continued application of cold; very long fasting; very innutritious diet; consuming grief, &c. For unless nature has regulated and established the balances of the system, and the uterine functions are on the point of taking place, we have every reason to believe that the equipoise of the various viscera is not disturbed from this cause, any more than in the male. This belief is founded upon three cases of the entire want of the menses in women from twenty-two to thirty years of age, who enjoy as fair a portion of health as females ordinarily do who menstruate regularly. And farther, because when this suspension takes place while puberty is pending, it will be found upon investigation that the uterus and vagina have secreted more than an ordinary quantity of fluid, and this periodically augmented—giving evidence thus, of its approaching capacity to furnish the menstrual fluid.

Symptoms. In enumerating the symptoms to which the "tardy appearance" of the menses gives rise, we shall confine ourselves exclusively in this instance to such as follow the failure of this discharge at the period at which it should appear; all other things being equal. In these cases, the development of such parts as unfold themselves by a sympathetic influence or consent, we suppose, have given evidence of a condition of the uterus, that declares it prepared, or nearly so, to take on the menstrual action, but which some cause or other has interrupted, and thus deranged a function every way essential to the well-being of the system in general.

For whenever the uterus and its appendages are in a pathological condition, to a degree that will suspend their functions, there will be no catamenial secretion. But this suspension is rarely (*immediately*) followed by ill health: on the contrary, we have seen many cases where there was a lapse of several months before the general system was placed in a pathological condition—and before this takes place, the female is not to be subjected to medical discipline; as the recuperative powers of the system alone will very frequently be sufficient to establish the suspended function.

When, on the other hand, we find the girl losing her bloom and strength; when we see her spirits flag, and she becomes the prey of gloomy apprehensions; when her stomach loses its wonted powers, and becomes whimsical in its selections of food; the circulation becomes hurried by trifling exertion; the heart palpitates, and a sense of suffocation is felt upon going up stairs, or up any other ascent; when the slightest unexpected noise or event shall throw her into nervous agitation; when she becomes watchful, until day dawn; emaciates rapidly, and her ankles swell; and when leucorrhœa, to a greater or less degree, adds its might to the other symptoms, the patient may then justly claim the best efforts of her physician.

The symptoms we have just detailed, are not the uniform attendants on this state of the uterus—though the greater part will be sure to present themselves, as the interruption may be of longer or shorter continuance. Head-ache, cold feet and hands, with a pale and almost bloodless skin, also belong to the list of evils. Constipation, or the opposite condition of the bowels, will present themselves; and that state of the system called *chlorosis* will soon ensue.

From what we have said, it will be perceived that the want of the catamenial flow may be caused by three different con-

ditions of the uterus. First, where development is incomplete; second, where it is complete or very nearly so, but, owing to certain influences, the discharge does not take place; and, third, where the failure is not owing to causes directly connected with the uterus and its appendages; or in other words, where this tardy menstruation is owing to the influence of certain chronic diseases in other parts of the system.

Now, these several conditions must not be treated by one general plan, if we expect success to follow our endeavours—on the contrary, each state of the uterus must be ascertained carefully, that we may not fall into an unsuccessful, empirical routine.

Diagnosis of condition first. We have already declared, that an organ cannot perform its final functions, until that organ be completely, or very nearly developed, or its organization be perfected. In the condition under consideration, we believe the development of the uterus to be imperfect, because, there is an absence of the sympathetic developments. Thus, the mammæ remain undistended; the pubes are not covered with hair; the voice has undergone no change; the neck is not increased, nor does the brain discover any augmented powers. Now, the absence of these signs would alone distinguish this first condition from the second, were this not aided by the general good health of the female. For in this condition, as in every other where the perfection of an organ is concerned, the system at large will not suffer from the want of a function of any one of the viscera, when that absence is owing to the period for development of any given viscus having not yet arrived—just so with the uterus—the system suffers nothing from the want of the menstrual discharge, if the period for its formation is not yet completed—or in other words, when its organization is not perfected.

Such being the case, this condition should not be the subject of medical treatment; for the non-appearance of the catamenia is not owing to a pathological state of the uterus, but to the absence of a certain physiological condition of this organ itself. Therefore, the mere absence of the menstrual discharge, under the circumstances just pointed out, must not be considered as disease, be the development of other portions of the body what they may. Hence the propriety of dividing condition first into two states—1st, where development has not commenced as above stated; and 2d, where it has made some progress. In state 2d, it is nevertheless true, that the development of the uterus may be slow, when compared with the expansion of the other portions of the body, and the number of years the subject has attained; or it may be more rapid, but still incomplete. In such cases, and they are far from being rare, we may constantly observe the effects of uterine development, in such parts of the body as should, agreeably to the order of nature, in a normal condition of the system, feel the influence of this progressive development; (as the pubes, the mammæ, the throat, neck, &c.) and thus should serve as guides for our remedial means, if we hope to base our therapeutical views upon just and rational principles, or upon well ascertained physiological laws. For it would be as idle, to say the least, to attempt the immediate production of the menses, by any plan we could adopt, in state 1st, as it might be successful in state 2d. These states consequently claim particular attention in a practical point of view, whenever we may be consulted for their relief. There is one sign, when it exists, which has never deceived us, so far; though we would not wish to be understood to say that we look upon it as infallible—for there may be exceptions; we allude to, a discharge from the vagina, of mucus, either slightly coloured, or nearly transparent; especially if it have a periodical increase or return—this circumstance is also worth bearing in mind.

Added to this latter symptom, there is pain in the back, hips, and down the thighs, especially at the periods at which this discharge is found to be augmented; together with slight micturition. Now, in state 1st there is an absence of all these signs, though the female occasionally may have the appearance of more general, but less particular development.

Treatment of condition first. From what has already been said, it will be perceived that patients of state 1st of this division are not considered as proper cases for medical treatment; though they may profit much from well-directed hygiene.

In cases of the kind we are now considering, the practitioner should never lose sight of the principle just laid down—namely, that *no organ can properly perform its assigned functions until its development is perfected*—consequently, the uterus cannot yield the menstruous fluid, until the part which elaborates it is sufficiently developed, to secrete it. It would therefore be idle, we must repeat,

if not entirely subversive of the constitution, to subject the female to a course of what is called emmenagogue medicines. For though we may aid development, under proper circumstances, we cannot absolutely originate it: this must be the act of the system—at least it must be begun by the influence of the laws that govern the successive developments of the body.

Let not the practitioner, then, be influenced by selfish motives, in cases of this kind—the only interest to be studied, is the welfare of his patient; and if this motive govern, he will, for the most part, only have to direct proper diet and exercise; or occasionally, such remedies only as may be necessary to the state of the general system, but without reference to the uterine in particular. Therefore, we shall, for the sake of perspicuity, characterize the two conditions in which patients of this class may present themselves, into, 1st, such as have no constitutional disease; and 2d, such as have.

1st. When a female arrives at the age at which it is common for the menses to appear, and they fail to do so, it is the almost universal belief that this must arise from the *failure* of a uterine function, which, if not removed, will occasion speedy, and perhaps incurable, ill health; than which, there cannot be, generally speaking, a greater error. For age, in the abstract, has nothing to do in the case. Not that we deny (for we have already conceded) that the catamenia generally flow, at a certain age of the female, in every particular climate; but, because the laws which govern the general developments of the body are put in force at certain periods, (by an original design of the Creator,) as these developments become essential to the well-being of the individual; yet, in certain cases, this law may fail to govern uterine development, at the usual period. And do not the facts insisted on in the commencement of this article, prove that more than mere age is necessary for the production of the catamenia, since they take place at various periods of female life? whereas, were this secretion governed solely by the age of the female, it should take place at nearly the same time, in every habitable part of the globe. And that this process is dependent upon the degree of development of the uterine system, is made certain by the fact, that the uteri of some women at eighteen, or even twenty, are as incapable of rendering the menstruous discharge, as at the age of but five or ten. Therefore, our therapeutics must not be influenced by the years of the female, but by the degree of development at which she has arrived.

Now, should a girl of from fourteen to sixteen or seventeen, who has never menstruated, be presented for medical advice, but who is in the enjoyment of good health, and who has not, agreeably to testimony, or observation, given any signs of development—that is, of enlarged mammæ, and the other tokens just mentioned, she must not be looked upon as in a condition for medical treatment, merely because she has arrived at, or exceeded, the period at which the menses are generally wont to appear in other females under the same latitude. But let your opinion be candidly stated, to this effect, with an earnest caution to the friends of the patient, not to interfere with the economy of nature, before signs of inability on the part of the uterus to produce this discharge, be made manifest. For we have every reason to believe, that until this happen, the system suffers nothing by the absence of the catamenia; and that the general health never depreciates until nature has made an effort to establish this discharge and has failed in the attempt.

Condition second of Sec. 1, or the non-appearance of the menstrual discharge, where there is evidence of uterine development. Here we must make another distinction, of practical importance, namely, that the loss of general health may not constantly depend upon an unsuccessful attempt to establish the menses, but may perhaps as often depend upon a pathological condition of some of the other viscera of the body; and to distinguish these states from each other is a matter of great interest to the patient.

If the ill health proceed from the first cause, namely, a want of power, or of condition, of the uterine system to produce the menses, that effort, though unsuccessful, will be accompanied by a certain degree of development of the parts sympathetically influenced by the organization of the womb and its appendages. If, on the other hand, the ill health depend upon an abnormal condition of some other viscus than the uterus, there will be in general an absence of the developments which mark the period of puberty. Therefore, the first supposition places the patient in state second of division the first, and will be treated of under that head; and the second will properly belong to the third general division of our subject, namely, where amenorrhœa is symptomatic.

In state 1st, it is, however, every way

desirable that the girl so circumstanced should be placed in the situation best calculated to preserve her health, by urging a proper degree of exercise, on foot, on horseback, dancing, &c. Also, by a well-regulated diet of digestible and bland food —avoiding over-stimulation of every kind, and keeping the bowels open, rather by a suitable diet, than by cathartic medicines.

It, however, occasionally happens, from causes not always easy to ascertain, that the whole system is in a state of debility, without any one organ being, strictly, in a pathological condition; yet, a state of general anemia prevailing, the appearance of the menses may be retarded beyond the usual period. In these cases, we do not suppose any special organic lesion, but such an abstraction, or absence of vital force, as will prevent a regular and well-timed development of the several systems, and in an especial manner, the uterine, as this is the last to be unfolded, and is very dependent upon the normal condition of the other systems, for its perfection.

Under such circumstances, it is noways surprising that menstruation is delayed; and this without the necessity of supposing the general system, or any particular portion of it, in a state of disease. Thus, a long-protracted illness; scanty fare, and an unhealthy atmosphere; long-continued, over-exertion, such as the duties required in manufactories; feeble original stamina; &c. &c. will produce this condition. In such cases, the patient sums up her situation in a few words, by declaring she has "no particular complaint —only she *is so weak*." The stomach, bowels, liver, kidneys, brain, &c. perform their functions regularly, if not vigorously; we have then only a general feebleness, or want of energy, to contend with; and for which, tonics are the remedies, aided by the abstraction, as far as possible, of the deleterious causes.

Of the tonics in such cases, the preparations of iron are decidedly the most efficacious—and of these, the phosphate, claims the preference. Of this, we give from four to five grains, four or five times a day, in powder, or in the form of pill. If the appetite be bad, two or three grains of the extract of gentian may be added to each pill. Or if the bowels be tardy, a quarter of a grain of aloes may be added, instead of the extract of gentian. A nourishing diet should accompany the preparations just named; and these should be aided, when practicable, by well-directed exercise. By this last, we mean such as shall not be carried so far as to produce fatigue.

The last observation is one of great moment, and should always be attended to, if profit be expected from exercise. There is no error more common than over-exertion, under the name of exercise; for fatigue is always followed by weakness. We do not mean by fatigue, a little lassitude from motion—for this is constantly the consequence of exercise, even when not carried to excess, and is perhaps not exceptionable. But exertion should never go beyond this; lest fatigue, which is an excess of lassitude, follow, and thus rob exercise of all its advantages.

Dancing, riding on horseback, shuttle-cock and battledore, skipping the rope, and swinging, are modes of exercise, the most desirable, as well as the most efficient. In these, the mind participates in the general benefit, by its being kept upon the alert, as well as constantly amused. Billiards, when they can be commanded, especially when walking or riding is ineligible from the state of the weather, is one of the best possible modes of exercise, as well as one of the most fascinating to the mind, keeping it constantly in a state of pleasurable excitement.

The surface of the body should be carefully protected against the vicissitudes of the weather—therefore flannel next the skin, is always to be worn. The feet should also be guarded against wet and cold, by proper coverings—nothing answering better for this purpose than the indian rubber over-shoes. The legs should be covered by stockings, and the thighs by drawers.

Treatment of State Second. Agreeably to our division, this state consists in amenorrhœa caused by some constitutional defect, which indirectly interrupts the normal development of the uterine system, by placing the greater part, or all, of the natural functions in a pathological condition; as girls of lymphatic temperaments are wont to be about the pubescent period. Now in such cases, there is almost constantly defective development of the general system, and with which the uterine participates—it would be therefore only a waste of time to attempt the direct production of the menses by the medicines termed emmenagogue.

All that should be attempted in such cases, is to favour the general development of the body, by means of diet and exercise; and if forced to give medicine by the importunity of friends, we should resort to a temporizing plan,

giving any inert substance by way of allowing time to the system to produce the necessary development of the uterus. This plan of proceeding is of more moment than may at first sight appear—we have seen fatal consequences follow the neglect of it.

Where development of the uterus proceeds slowly, it may be assisted by the general means mentioned above; especially by the preparations of iron. But in these cases, evidence of such development is sure to appear in the parts that indicate puberty. We may here employ such remedies as have an indirect influence upon uterine development—of these, the aloes has a decided advantage, and the following formula has been found to answer extremely well.

℞. Gum. aloes. suc. ℥ss; Pulv. Rhœi. ʒj; Ol. Caryoph. gutt. iv; Sapo. venet. gr. viij; Syr. Rhœi. q. s. M. f. pil. LX. S. One of these may be taken every night at bed-time, or every other night, or oftener if necessary; the object being to keep the bowels regularly open, but not purged.

A train of nervous symptoms are wont to show themselves; as does, sometimes, leucorrhœa. The former may be quieted by valerian, assafetida, Hoffman's anodyne liquor, &c.; the latter, by the tincture of cantharides, &c. In these cases, a discrimination of importance is to be made—namely, that this affection only merits attention when the general health suffers.

It sometimes happens that the uterus, &c. have been fully perfected, but the menstruous secretion does not take place; owing most frequently to leucorrhœa, relieving the congestion essential to this secretion. When this is the case, the girl generally complains, and this periodically, of pain in the back, hips, and loins, with a sensation of fullness in the pelvis, which is sometimes attended by a forcing, or bearing down. Sometimes there is periodically a serous discharge, resembling, leucorrhœa, though differing from it, in being thinner, more transparent, and recurring at about a menstrual period.

These cases are relieved promptly by the Tinct. Lyttæ, if leucorrhœa attend; in doses of twenty or thirty drops, three times a day; or if near the period of return of the above named symptoms, by the infusion of madder, in the proportion of an ounce (powdered) to a pint of boiling water; this should be simmered for a few minutes, allowed to settle, and strained—a few cloves may be added to make it more palatable—and sugar, if desired. A wine-glass-full is to be given every three hours.

During the whole treatment, a strict attention must be paid to diet, exercise, clothing, &c., as recommended above. And should this case be attended by anemia, the chalybeates must be added to the treatment.

Sect. 2. *Of the default of the menses, after having been regularly, or partially established. Causes.* A variety of causes, if permitted to act, may interrupt the menstruous secretion, however regularly it may have been established previously; of these causes, cold improvidently applied either before, during, or immediately after the flow, will cause an interruption. When the suppression is owing to cold applied in the interval of menstruation as a remote cause, there is no immediate inconvenience experienced for the most part, nor is the woman sensible that any injurious effect has been produced, until the failure at the next period warns her that mischief has been done; but even then, no unpleasant feelings arise, nor perhaps for several succeeding periods.

Symptoms. If the menstrual interruption implicates the system, one of the first symptoms noticed is languor, succeeded by paleness, emaciation, and a variety of what are termed nervous symptoms; such as palpitation of the heart, a sense of suffocation, especially on rising any ascent, and leucorrhœa—this latter, however, rarely takes place in women who have not been generally subject to this complaint, before there is a general deterioration of health, and thus points out the necessity of immediate succour.

Nature herself very often restores this discharge without the interference of the physician, and for this reason it is not always a case for medical care; on the contrary, we rarely prescribe for recent cases, but wait until it becomes doubtful whether the powers of the system unaided will be sufficient for this purpose. So soon as this suspicion, however, arises, we are instantly upon the alert. We believe this to be the proper management of such cases; as we are very sure that much mischief has arisen from the too early application of remedial means. For this reason we wait for evidence that the system requires aid, by the symptoms just named presenting themselves; but which rarely happens until the menses shall fail to appear, after the lapse of the third or fourth period, unless this absence should be accompanied by a

more or less profuse leucorrhœa; for this will make the system flag somewhat earlier.

Treatment. Few complaints of the system are prescribed for with such evident empiricism, as the "suspension of the menses;" yet no one of them requires more accurate discrimination—for no one remedy or mode of treatment will succeed in all cases. With a view, therefore, to the more complete understanding of the indications to be followed in the variety of amenorrhœa now under consideration, we shall divide the condition of the system into three different states—for it is owing to the want of these distinctions that its treatment is often unsuccessful.

1. Where the arterial system has not departed, or but very little, from its natural or healthy standard;

2. Where its action is too much exalted;

3. Where it is below its natural standard.

1st. Where the arterial system is but little or not at all excited, we need not employ any active depletion, but we must be careful not to administer any violent stimulants, as large doses of the spirituous tinctures, a rich full diet of both durable and diffusible stimuli, savin, oil of pennyroyal, &c., lest we convert this state of the system into one of high action, and thus defeat the objects of our prescriptions. On the contrary, we should order a milk and vegetable diet; the bowels to be kept sufficiently or regularly open; an abstinence from every kind of liquor, and a freedom from much exertion or exercise.

By keeping this rule in view, we gain much time for ourselves, and much advantage for our patients; for by it we prevent the necessity of combating fever, or a high degree of arterial action, and thus give to our remedies a more undisturbed possession of the system, and consequently a better opportunity to effect their ultimate object. We are aware that this is not the view that is generally taken of the state of the system, or of the mode of treatment; but an ample experience unquestionably decides in its favour.

We would vary our treatment in this condition, as the expected period may be nearly, or more remotely, at hand. In the first case, it would be well, a day or two before the arrival of the period, to try the decoction of madder, as already suggested; to bathe the feet, before going to bed, in the warm mustard bath, and give an aloetic purge. If the period be more distant, or has just passed, we should commence with Tinct. Lyttæ, in thirty or forty-drop doses, three times a day, using the means just named, at the time then pointed out. In this plan, perseverance is necessary for some two or three months; at the end of which period it rarely fails to effect the purpose for which it is prescribed. If, during the use of these means, the general health is found to improve, we may calculate with much certainty that they will ultimately succeed; and especially if leucorrhœa be an attendant, and it is found to abate.

Should these remedies, however, fail, and the complaint become chronic, we should employ the volatile Tincture of Guaiacum, made according to the following formula.

℞. Pulv. G. Guaiac. ℥iv; Carbon. Sodæ vel Potass. ℥iss; Pulv. Pimento. ℥j; Alcohol Dilut. ℔j; M. and digest for a few days. The aqua ammon. is to be added pro re nata, in the proportion of one or two drachms to every six ounces of the tincture, according to the state of the system.

A tea-spoon-full of this tincture is to be given every morning, noon, and evening, in a wine-glass-full of sweetened milk; or what is more agreeable, in a glass of sherry, Teneriffe, or Madeira wine, if this be admissible. Should it open the bowels too freely, a few drops of laudanum must be added to each dose. Or should it not prove sufficiently aperient, a little resin of jalap or powdered rhubarb may be added.

This medicine seldom or never fails in chronic idiopathic amenorrhœa; accordingly we place more reliance upon it in the cases proper for its use, than any other remedy. It is true, it may fail in some instances even of idiopathic amenorrhœa; but these constitute only exceptions. It will certainly fail, in symptomatic amenorrhœa, from phthisis pulmonalis, &c. &c. and where this disease arises from an organic lesion of the uterus. When these conditions can be ascertained, this remedy should be withheld, not only as useless, but perhaps mischievous.

An Italian physician, Lavagna, has highly extolled injections, per vaginam, of a solution of ammonia. His mode of using this substance is, to add ten or twelve drops of aq. ammon. pur. to every ounce of milk; of which several ounces, that is, two or three, may be thrown up the vagina by means of a female syringe, four or five times a day—it should excite a glow, but not produce pain. If the first be not felt, a few drops more of the ammonia may be added; if the second, a little less must be used.

We regret that we cannot add our tes-

timony to that of others, in favour of this remedy, as it has utterly failed in our hands, though pushed to the full extent we dared, in several instances; and this, under as favourable circumstances as we could well select.

2. *Where arterial action is exalted.* This state must be carefully distinguished from either the preceding or the following, as the success of remedies will mainly depend upon the discrimination. In the state under consideration, the first indication is to reduce the force of arterial action, by blood-letting, from the arm, or preferably from the foot; by a strict antiphlogistic regimen, and by purging. After the pulse is reduced to the proper standard by these means, the patient is now in the condition to receive benefit from the remedies named for State 1, and must be treated in like manner in every respect, cæteris paribus. It may be well to mention, en passant, that cold suddenly applied at the time the menses are flowing, will not only check the flow, but also give immediate rise to hysterical or colicky affections. These must be treated upon general principles, by bleeding, purging, warm bath, &c. The best remedies for the colicky pains, are camphor, and purging with the elixir proprietatis.

3. *Where the force of arterial action is below the natural standard.* In these cases, it is not the pulse alone that betrays the languid state of the system; for all the symptoms of *anemia* will be present. Nor is this condition confined to the very young girl; it is often to be found at the more advanced periods of life, and has for its cause, in the cases we are treating of, the "idiopathic amenorrhœa." In such cases, the preparations of iron, tonics, the bitters, suitable exercise, and a generous diet, are the remedies.

Sect. 3. *Where the menstrual evacuation is arrested by the influence of certain chronic affections of other portions of the system.*

We shall not dwell upon this division of our subject, longer than to caution the young practitioner against mistaking the effect, for the cause, of ill health. We have already endeavoured to give the diagnoses of these two conditions, to which we now refer—for the practitioner may be assured, that every attempt to restore menstruation, when its stoppage is symptomatic, will prove unsuccessful, until the original disease be removed. It is then, and then only, that any attempt should be made for this purpose, if nature does not relieve the embarrassment herself.

But should the cause of amenorrhœa be removed and the menses fail to appear, the patient should be treated according to one of the three states we have supposed the arterial system to be in while labouring under this complaint.

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I. H.

AMIDINE. (From *Amidon,* Starch.) (See *Amyline,* and *Starch.*) I. H.

AMMONIA. (From Sal *Ammoniac*, the name of one of the principal salts of ammonia, so called by the ancients, from its being found in abundance in the neighbourhood of the temple of Jupiter *Ammon.*)

Ammonia is a peculiar inorganic alkali, consisting of nitrogen and hydrogen, and distinguished from the *fixed alkalies* by its non-metallic constitution and gaseous nature. On account of the latter property, it is frequently called the *volatile alkali*. It exists in small amount in the mineral, vegetable, and animal kingdoms; but when obtained in large quantities, is always a product of art. In the mineral kingdom it occurs as muriate of ammonia in the neighbourhood of volcanoes, and, in very small quantities, in the native oxides of iron, in clays, and some other minerals. In a free state, it has been detected by Chevallier and Lassaigne in certain plants, as the *Chenopodium vulvaria*, the *Sorbus aucuparia*, &c., and variously combined, in certain animal secretions. Sometimes it becomes formed in the inorganic kingdom, when a body is oxidized at the same time by air and water, as when iron filings are exposed to a moist air; and it is a constant product of the decomposition of *azotized* organic matter, whether animal or vegetable, when undergoing putrefaction or subjected to an elevated temperature.

Animal matter, on account of its being rich in *nitrogen*, is almost exclusively employed for obtaining ammonia. For this purpose it is subjected to destructive distillation. The ultimate constituents of this matter, with the exception of fat which contains no nitrogen, are hydrogen, carbon, oxygen, and nitrogen. These elements, by entering into new combinations, give rise to a number of new products, among which the most abundant is ammonia.

The animal matters usually employed in this distillation are refuse horns and bones. Sometimes woollen rags and cuttings are employed. Formerly the horns of the hart were used, and hence has arisen the popular name of this alkali, *hartshorn*. The materials are distilled in a cast-iron cylinder, placed horizontally over a reverberatory furnace. One extremity of the cylinder is so arranged as to open and shut conveniently, and forms the place at which the matters are introduced; while the other terminates in a capacious curved tube which passes into a cask. This, by means of other tubes, is made to connect successively with a number of casks, from the last of which, a tube is turned back, so as to terminate in the furnace, where the incondensible products are emitted and consumed. This latter tube should contain several partitions of wire-gauze, in order to prevent the flame from retroceding and causing explosions. The products consist of water, empyreumatic oil, a small quantity of acetate and hydrocyanate of ammonia, together with a large quantity of impure carbonate of ammonia, partly dissolved in the water, and partly in a concrete state. All these substances, except a small portion of the water, are new products, generated by a new arrangement of the elements of the animal matter.

The impure carbonate of ammonia, obtained as above explained, is the parent of all the ammoniacal compounds; since it is concerned, either directly or indirectly, in the production of every individual of the class. When its solution is allowed to filter through a stratum of sulphate of lime (plaster of Paris), it is converted into sulphate of ammonia; and this latter, by being heated with chloride of sodium (common salt), gives rise to muriate of ammonia which sublimes, and sulphate of soda which remains as a fixed residue. In this manner having obtained the muriate of ammonia, we possess the most convenient salt for yielding gaseous ammonia, or the alkali in question in a pure state.

Preparation of Ammonia. Being possessed of the muriate, all that is necessary in order to obtain ammoniacal gas, is to mix the salt in fine powder with twice its weight of pulverized lime, and to expose the mixture to a gentle heat. The muriatic acid combines with the lime, while the ammonia is evolved. As it is largely absorbed by water, it must be collected over mercury.

Properties. Ammonia is a transparent, colourless, gaseous fluid, having an acrid and hot taste, a pungent smell, and a strong alkaline reaction. Its specific gravity is 0.59. On account of its strongly stimulating properties, it is irrespirable, the glottis closing spasmodically, when the attempt is made to breathe it. When a lighted taper is immersed in the gas, it is extinguished, but just before it goes out, its flame is enlarged in consequence of the combustion of a small portion of the gas. When passed over heated iron or copper, it is decomposed, and these metals undergo a remarkable decrease of density, attended, in the case of the former metal, with an increase of weight, amounting to $11\frac{1}{2}$ per cent., caused by the absorption of nitrogen. When mixed with any gaseous acid, as, for example, the carbonic or muri-

atic, it immediately forms a white precipitate like snow, consisting of the carbonate or muriate of ammonia. This property forms a very delicate test of the presence of ammonia, and may be taken advantage of to detect the gas, when all other means fail. For this purpose, it is merely necessary to hold a glass stopper, wet with muriatic acid, near the liquid supposed to contain ammonia; whereupon the stopper will be surrounded with a white vapour, in case the alkaline gas be present.

Ammonia may be condensed into a liquid either by a cold of —40°, or by the combined influence of cold and pressure. In the condensed state, it is colourless and possessed of a high degree of fluidity, and has a specific gravity of about 0.76.

Ammonia is absorbed in large amount by water, and to a considerable extent by alcohol. The liquids which result are used in medicine under the names of *water of ammonia* and *ammoniated alcohol*, and will be noticed in detail among the pharmaceutical preparations, forming the sequel to this article.

Ammonia is an important salifiable base, and as such forms a numerous class of salts. These are all colourless and possess a sharp and saline taste; and, with the exception of the fluoborate of ammonia which is liquid, are solid at ordinary temperatures. They are easily distinguished from other salts by the fact, that, when mixed with a hydrated fixed alkali, or with an alkaline earth, they disengage ammonia, recognizable by its smell, or by its forming a white fume around a glass rod, held over the mixture after having been dipped in muriatic acid. The greater number of them are neutral, though several possess an alkaline reaction, and an ammoniacal odour. The former always contain water, while the latter are anhydrous. When exposed to heat, some of the ammoniacal salts volatilize without decomposition; others abandon their ammonia while the acid remains; but the majority of them suffer a mutual decomposition of their acid and base; the hydrogen of the ammonia forming water with the oxygen of the acid which is reduced either in whole or in part, and the nitrogen being set free. Many of the salts of ammonia, when their solutions are evaporated, lose ammonia and become acid. Hence it is necessary, when it is wished to crystallize these solutions, to add, upon the completion of the evaporation, a sufficient quantity of ammonia to make up for that which is lost.

A number of the ammoniacal salts are interesting either in a chemical or medical point of view. Those used in medicine will be described among the pharmaceutical compounds of ammonia, described at the end of this article; the remainder will be noticed in this place.

Sulphate of ammonia is obtained on a large scale from the impure carbonate of ammonia, already mentioned; and is made extensively for the sole purpose of being sublimed with common salt in the fabrication of muriate of ammonia. The impure carbonate in solution is mixed with powdered sulphate of lime, or made to filter through a layer of this salt. By double decomposition, sulphate of ammonia and carbonate of lime are generated. According to Berzelius, the sulphate is sometimes formed by mixing a solution of the impure carbonate with one of sulphate of iron (green vitriol), or sometimes of alum. The ammonia combines with the sulphuric acid, and the oxide of iron, or alumina is precipitated. In England the sulphate of ammonia is frequently obtained from the ammoniacal liquor generated in coal-gas works, and in Scotland, by lixiviating the soot of sulphureous coal. However obtained, it is a colourless salt, of a sharp, bitter taste, soluble in twice its weight of cold water, and in about its own weight of boiling water. It consists of one equivalent of acid 40, one of ammonia 17, and two of water $18 = 75$.

Nitrate of ammonia is easily formed by saturating nitric acid by means of carbonate of ammonia, and evaporating the solution. This salt is deliquescent and very soluble in water. It is obtained either in prisms, fibrous crystals, or a brittle compact mass, according to the temperature at which its solution is evaporated. It is interesting as being the most convenient substance from which the *nitrous oxide* can be obtained; for when heated to a temperature of between four and five hundred degrees, it is totally resolved into this gas and water. Its composition is one equivalent of acid 54 to one of base $17 = 71$.

Soda-phosphate of ammonia was formerly called *microcosmic salt*, and *fusible salt of urine*, and is employed in the same manner as borax, in assays with the blowpipe. It exists in considerable quantities in the urine, from which it may be obtained by evaporation. When exposed to the air, it effloresces and loses part of its ammonia. It consists of one equivalent, each, of phosphate of ammonia, and phosphate of soda, united with ten equivalents of water.

Oxalate of ammonia is very much em-

ployed by the chemist as a reagent for detecting lime, with which the oxalic acid forms an insoluble oxalate of lime. It is formed by neutralizing ammonia with oxalic acid. It is a crystallized salt, very soluble in water, consisting of one equivalent of oxalic acid 36, one of ammonia 17, and two of water 18 = 71. *Succinate of ammonia* is employed in analysis for the purpose of separating the peroxide of iron from other oxides. The solid salt is always acid; and hence when dissolved in water to be employed in precipitating iron, the solution must be neutralized before it is used; for otherwise, the precipitated succinate of iron would be dissolved in the process of washing.

Composition of Ammonia. This alkali consists of one equivalent of nitrogen 14, and three of hydrogen 3 = 17; or, in volumes, of one volume of nitrogen and three volumes of hydrogen, the four volumes condensed into two. That this is its composition in volumes is made evident by the result of its analysis by electricity; for when subjected repeatedly to the electric spark, two volumes are resolved into four of a mixture, one-fourth of which is nitrogen, and three-fourths hydrogen. Scheele was the first chemist who ascertained that the constituents of ammonia were nitrogen and hydrogen; but it was Berthollet who determined with any precision the proportions in which they are combined.

It has already been mentioned that the neutral salts of ammonia contain water. Resting mainly upon this fact, Berzelius has formed a theory respecting these salts which assigns to them a metallic oxide base, and thus makes them assimilate, in composition, with the salts of the fixed alkalies. In all these ammoniacal salts, Berzelius supposes one equivalent of ammonia and one of water to form a peculiar metallic oxide, with which the acid is combined. Thus the ammonia consists of one equivalent of nitrogen and three of hydrogen, and the water, of one equivalent of hydrogen and one of oxygen. The hydrogen of the water united with the constituents of the ammonia is supposed to constitute a peculiar compound metal, called by Berzelius *ammonium*, consisting of one equivalent of nitrogen and four of hydrogen; and the oxygen of the water is alleged to constitute, with this ammonium, a metallic oxide. When mercury is electrified in contact with muriate of ammonia, it combines with the elements of ammonia, but with an excess of hydrogen, and becomes greatly enlarged in bulk without losing its metallic properties. This experiment, Berzelius considers to prove that what the mercury gains, must be metallic matter; as otherwise it would lose its metallic character. With the exception of the presumption created by this experiment, ammonium is altogether a hypothetical substance. The theory which supposes its existence is plausible; but there are several strong objections to its truth. Thus ammonia is confessedly a strong alkali; and it would be contrary to all analogy to suppose that by gaining more hydrogen, it could become metallic. In fact, it would be making a metal contain an alkali, instead of the alkali, a metal, as is the case with the fixed alkalies. It may be objected also, that the theory does not explain all the cases of the ammoniacal salts; for besides the salts of *ammonium*, Berzelius is forced to admit the existence of salts of *ammonia*, as where a dry acid, carbonic acid for example, combines with dry ammonia.

Therapeutical Applications. Ammonia, as used in medicine, is variously combined; and in its different combinations, its effects on the animal economy are in many cases different. In the gaseous state, or when combined with water, it acts as a powerful irritant and stimulant. In the former state and diluted with air, as emitted from the water or carbonate of ammonia, or from a mixture of the muriate with lime or carbonate of potassa, it is applied as an excitant to the nostrils for nervous head-ache and fainting. The substances employed are generally scented with some agreeable volatile oil, and in this state form the contents of the different smelling-bottles of *volatile salts*, so frequently employed.

For an account of the general effects of ammonia upon the system, and its therapeutical applications, the reader is referred to the head of *carbonate of ammonia;* as this is the form under which the alkali is most commonly employed as a remedial agent; and the remarks applicable to the carbonate, are for the most part applicable also to ammonia in its caustic state. The peculiar effects of the other medicinal combinations will be mentioned under the head of each.

Pharmaceutical Preparations. The chief pharmaceutical preparations of ammonia are *water of ammonia*, *ammoniated alcohol*, *muriate*, *carbonate*, and *bicarbonate of ammonia*, and the *solutions of acetate of ammonia* and *of hydrosulphate of*

ammonia. These several preparations will be noticed, under distinct heads, in the order here named.

Water of Ammonia.—*Aqua Ammoniæ*, Ph. U. S. et E. This preparation, usually called *liquid ammonia*, is obtained, according to the U. S. and Edinburgh Pharmacopœias, by heating, in a glass retort placed on a sand bath, a mixture of one part of muriate of ammonia with one and a half parts of lime, the latter, previously to the mixture, being slaked with a sufficient quantity of water; and allowing the ammoniacal gas, as it is evolved, to be absorbed by a portion of distilled water. By the superior affinity of the lime for the muriatic acid, muriate of lime is formed; and at the same time gaseous ammonia is evolved, which is absorbed by the distilled water. According to the London and Dublin formulæ, a solution of muriate of ammonia is added to slaked lime, and a determinate quantity of the liquid drawn over by distillation. Here the rationale is the same as when the preparation is obtained by the other process; the only difference being that the water intended to absorb the ammonia is present in the retort, and is distilled over, more or less saturated with the gas, into the receiver.

Water of ammonia is generally prepared on the large scale by the manufacturing chemist. In order to save the expense of glass retorts, a cast-iron boiler is conveniently employed, furnished with a copper head, communicating with two glass vessels, the first empty, to detain any impurities which may distil over with the gas, the second, half filled with distilled water. When a strong liquid ammonia is required, the water employed to absorb the gas should equal in weight the muriate decomposed. The manufacturing chemists generally make a strong preparation, and afterwards dilute it sufficiently with water, to bring it down to the medicinal standard. Sulphate of ammonia when acted on by lime, will yield ammoniacal gas, and, hence, may be substituted in this process for the muriate. M. Payen has proposed it for this purpose, and states that its employment affords economical results.

Properties. Water of ammonia is a colourless liquid, of an acrid taste, and peculiar, pungent smell. It acts as a caustic on animal matter, and blisters by its contact the tongue and skin. It has a strong alkaline reaction, and instantly changes turmeric paper to reddish-brown, when held over its fumes. Cooled rapidly to 40° below zero, it assumes a gelatinous consistency; but when gradually refrigerated to the same point, it crystallizes in long needles possessing a silky lustre. When heated sufficiently, it enters into ebullition with disengagement of the gas; its boiling point being always lower, in proportion as it is more concentrated. It has a very strong attraction for carbonic acid; and hence, if insecurely kept, it absorbs this acid, which may be detected by the preparation effervescing with acids, or by its affording a precipitate with lime-water. When perfectly pure, it evaporates in a glass capsule without residue. It combines with oil, and forms a liquid soap, and dissolves resins and other vegetable principles. Its specific gravity varies with its strength, being always less, in proportion to its concentration. When as concentrated as possible, its density is 0.875 at the temperature of 50°. Its officinal strength is by no means so high; but varies somewhat according to the different pharmaceutical authorities agreeably to which it is made. It is 0.939 in the Edinburgh Pharmacopœia, 0.944 in that of the United States, 0.950 in the Dublin, and 0.960 in the London; the amount of gaseous ammonia present varying, between the extremes, from about 10 to 16 per cent. The French medicinal water of ammonia is stronger than any of these preparations, as it has a specific gravity of 0.923 and contains about 20 per cent. of ammonia.

Composition. When water is fully saturated with ammonia, it takes up about one-third of its weight, or 430 times its volume of the gas, and increases in bulk about two-thirds. It is seldom obtained, however, so concentrated as this, but varies exceedingly in strength, according to the care with which it is prepared. In order to facilitate the determination of the proportion of the gas in different samples of liquid ammonia, tables have been constructed, showing the per centage of ammonia corresponding to different densities. The following table, constructed by Sir H. Davy, is of this kind, and may prove useful to the practical chemist.

Specific Gravity.	Ammonia per cent
0.8750	32.50
0.8875	29.25
0.9000	26.00
0.9054	25.37
0.9166	22.07
0.9255	19.54
0.9326	17.52
0.9385	15.88
0.9435	14.53
0.9476	13.46
0.9513	12.40
0.9545	11.56
0.9573	10.82
0.9597	10.17
0.9619	9.60
0.9692	9.50

In using this table, all that is necessary is to take the specific gravity of any sample of water of ammonia, and, then, by inspection, to ascertain the per centage of ammonia corresponding thereto.

Therapeutical Applications. Water of ammonia is stimulant, antacid, rubefacient and vesicatory. As a stimulant, it is occasionally employed in hysteria, fainting, asphyxia, and similar affections, for the purpose of rousing the vital powers. As an antacid, it is a useful remedy in heart-burn, and for the relief of sick head-ache when dependent on acidity. The dose is from 5 to 20 drops, according to its strength, largely diluted with water to prevent its caustic effect on the mouth. The water of ammonia of the Edinburgh College is inconveniently strong for internal use, and hence that College have directed an *Aqua Ammoniæ Diluta*, of one-third the strength of the strong preparation. Externally, water of ammonia is used as a rubefacient, being the chief ingredient of several liniments. The *liniment of ammonia* or *volatile liniment* (*Linimentum Ammoniæ*, Ph. U. S.) is a *liquid soap*, made by mixing half a fluidounce of water of ammonia with two fluidounces of olive oil, and is very much used as a stimulating liniment in rheumatic pains and sore throats. The *compound camphor liniment* (*Linimentum Camphoræ Compositum*, Ph. L. et D.) is a solution of camphor in a mixture of water of ammonia and spirit of lavender, and is used for the same purposes as the liniment of ammonia. The *liniment of mercury* (*Linimentum Hydrargyri*, Ph. L.) is prepared by mixing an ounce of camphor, rubbed up with 15 minims of alcohol, with 4 ounces, each, of mercurial ointment and lard, and 4 fluidounces of water of ammonia. It is used as a stimulating liniment and discutient in glandular swellings and venereal tumours, as swelled testicle, buboes, &c. When water of ammonia is employed as a vesicatory, a piece of linen of the size of the blister desired, is wet with it and applied to the part intended to be vesicated. When this effect is required, it is doubtful whether the weaker waters of ammonia would prove sufficiently irritating.

Toxicological Properties. Poisoning by water of ammonia is exceedingly rare, on account of its pungent odour, which prevents its being taken by mistake. ORFILA concludes, from his experiments on dogs, that it acts as an irritant poison, producing death, sometimes by acting on the nervous system, particularly the spine, and sometimes by producing an inflammation of the alimentary canal, and secondarily a lesion of the brain. In cases of poisoning by this alkali, it is supposed that diluted vinegar, acting by its neutralizing power, would form the best antidote. Unfortunately the poison acts with great rapidity, and hence the necessity of extreme promptitude in applying the necessary remedies. If the patient survive the first shock, the consecutive inflammation must be combated by the usual antiphlogistic remedies.

AMMONIATED ALCOHOL. Spirit of Ammonia.—*Alcohol Ammoniatum*, Ph. U. S. et E. This preparation, according to the United States and Edinburgh Pharmacopœias, is merely a solution of ammonia in alcohol (rectified spirit). The nearest corresponding preparations of the London and Dublin Colleges are solutions of carbonate of ammonia, in proof or rectified spirit. That of the London Pharmacopœia is made by distilling a mixture of muriate of ammonia, carbonate of potassa, and proof spirit. By double decomposition, carbonate of ammonia is formed, which distils over with the proof spirit, while the muriate of potassa remains behind. The Dublin formula consists in simply dissolving the officinal carbonate (*sesquicarbonate*) of ammonia in rectified spirit. During the solution, just so much carbonic acid is extricated as to convert the sesquicarbonate into the regular carbonate, of which 30 grains are dissolved in each fluidounce of the spirit, to form a saturated solution.

Therapeutical Applications, &c. Ammoniated alcohol is a colourless liquid, of an exceedingly pungent smell and acrid taste. The corresponding preparations of the London and Dublin Colleges have the same general properties, though in a milder degree, on account of the ammonia contained in them being carbonated. It is sometimes given as a stimulant in doses of from 20 to 50 drops in a wine-glass-full of water. When these compounds are impregnated with aromatics, they constitute the *aromatic ammoniated alcohol*, and *aromatic spirit of ammonia*, preparations much more employed, on account of their grateful taste, than simple ammoniated alcohol.

Ammoniated alcohol is employed as a menstruum for certain medicines, forming a class of preparations called *ammoniated tinctures;* among which may be enumerated the ammoniated tinctures of guaiac, opium, Peruvian bark, and valerian, the ammoniated spirit of meadow-saffron, and

the fetid and succinated spirits of ammonia, the latter preparation being intended as a substitute for the *eau de luce*.

MURIATE OF AMMONIA.—*Ammoniæ Murias*, Ph. U. S.—L. et D. This salt exists in nature, being found in the craters of certain volcanoes, and occasionally in coal mines. It occurs, also, ready formed, in the urine and dung of some animals. Formerly it was prepared only in Egypt, where it was obtained by sublimation from the soot of camels' dung. At present it is made in different cities in Europe by pure chemical means. The process consists in mixing the crystallized sulphate of ammonia, obtained in the manner already described, with common salt, and exposing the mixture, placed in stone-ware vessels, to a quick heat. By double decomposition, there are formed muriate of ammonia, which sublimes into the upper part of the vessels, and sulphate of soda, which remains behind. Sometimes the sulphate of ammonia and common salt are dissolved together in water, and the mixed solution is evaporated to the point of crystallization; whereupon the muriate of ammonia crystallizes first, and sulphate of soda afterwards. The muriate is then placed in conical moulds to drain, and afterwards the masses are piled up and dried. The crystallized muriate of ammonia, thus obtained, is not so pure as the sublimed; as it generally contains a portion of sulphate of soda.

Properties. Sublimed muriate of ammonia is in the form of concavo-convex semitransparent cakes, of great tenacity, and difficult to be reduced to powder. Its taste is sharp and saline, and its specific gravity 1.45. It dissolves in 2.72 parts of cold water, and in its own weight of boiling water, and is soluble also in alcohol. It crystallizes generally in feathery crystals, less frequently in cubes or octohedrons. By the action of chlorine on its solution, a violently detonating liquid, called *chloride of nitrogen*, is formed. It is readily recognized by the combined indications of lime, which extricates the ammonia, and of strong sulphuric acid, which sets free white vapours of muriatic acid. It consists of one equivalent of muriatic acid 37, and one ammonia 17=54, or two volumes of each, condensed into a solid. BERZELIUS, by supposing the hydrogen of the acid to be transferred to the ammonia, makes it a *chloride of ammonium*. It is employed in the arts for preserving metals bright preparatory to soldering, and in some of the processes of calico-printing.

Pharmaceutical Uses. Muriate of ammonia is used in pharmacy for the production of gaseous ammonia by the action of lime, and for the preparation of carbonate of ammonia, ammoniated iron, and ammoniated mercury.

Therapeutical Applications. Muriate of ammonia is deemed an alterative, and stimulating diaphoretic and diuretic. It has been used in catarrhal and rheumatic fevers, and in pneumonia, bronchitis, pulmonary catarrh, and other inflammations, after their first violence has abated. Its alterative effect has been found beneficial in the treatment of indolent tumours, visceral obstructions, catarrh of the bladder, leucorrhœa, and affections of the bowels, characterized by increased mucous secretion. According to SUNDELIN, it is a good remedy in amenorrhœa, when dependent on atony of the uterus, and in sub-inflammatory chlorosis. The dose is from 5 to 30 grains.

Externally applied in solution, it is a valuable remedy. Sometimes it is employed at the moment it is dissolved, as a sedative lotion to the head in mania, apoplexy, and violent head-ache, in which cases it acts by the cold which it produces. It is frequently applied, also, as a stimulating discutient to indolent tumours. The lotion may be formed by dissolving an ounce of the salt in a pint of water.

CARBONATE OF AMMONIA. Mild volatile alkali.—*Ammoniæ Carbonas*, Ph. U. S. et D. The officinal carbonate of ammonia is obtained from the muriate, usually by subliming it with carbonate of lime or chalk. The carbonic acid combines with the ammonia, and the muriatic acid with the lime, so as to form chloride of calcium and water. The carbonate of ammonia and water sublime together, forming a hydrated carbonate, and the chloride of calcium is left behind. The Dublin College forms this preparation by subliming the muriate with carbonate of soda, and the rationale is similar to that just given; the only difference being that the residue is chloride of sodium, or common salt, instead of chloride of calcium. In conducting this process, the retort should be of earthenware, and have a wide cylindrical neck; and the receiver should be cylindrical also, to facilitate the extraction of the sublimed carbonate. The decomposing salt, whether carbonate of lime or of soda, should be used in excess, to insure the complete decomposition of the muriate; for, otherwise, a part of this would be apt to sublime along with the ammoniacal carbonate. The use of carbonate of soda is said to afford a whiter product, but is objectionable on the score of expense.

On a large scale, carbonate of ammonia is generally made by subliming the usual materials from an iron pot into a large earthenware or leaden receiver. According to PAYEN, sulphate of ammonia may be substituted for the muriate with economical results; and when used, the residue will of course be sulphate of lime. Carbonate of ammonia is manufactured in large quantities from the ammoniacal products, obtained in the distillation of coal, in coal-gas works; but when thus obtained, it is apt to have a slight smell of coal tar, and to leave a blackish matter when dissolved in acids.

Properties. Carbonate of ammonia, when fresh, is in white, moderately hard, translucent, crystalline masses, of a fibrous texture, pungent smell, and sharp penetrating taste. It possesses an alkaline reaction, and when held under a piece of turmeric paper, changes it to brown, owing to the ammonia which escapes. When long or carelessly kept, it gradually passes into the state of bicarbonate, becoming opaque and friable, and much less pungent. In this state, it should never be put up in prescriptions for the officinal carbonate. It is soluble in twice its weight of cold water, and in less than its weight of warm water. Its solution is officinal with the British Colleges; but in this state, it is not a good preparation, as it is liable to change by keeping. Boiling water decomposes it, with effervescence of carbonic acid. It dissolves abundantly in diluted alcohol, and with effervescence of carbonic acid, in alcohol of 0.836. When heated on a piece of glass, it ought to evaporate without residue; and if turmeric paper, held over it, undergoes no change, it is a proof that it has passed into bicarbonate.

Carbonate of ammonia is decomposed by acids, the alkalies whether pure or carbonated, lime-water, magnesia, muriate of lime, supertartrate of potassa, corrosive sublimate, acetate and subacetate of lead, the sulphates of iron and zinc, and the preparations of iron, with the exception of the tartrate of iron and potassa.

Composition. This salt consists of three equivalents of carbonic acid 66, two of ammonia 34, and two of water 18=118. The medicinal carbonate of ammonia, when perfect, is, therefore, a hydrated *sesqui*carbonate, and not a *sub*carbonate, as it is called by the London and Edinburgh colleges. It is considered by these authorities to be a sub-salt, on the ground of its having an alkaline reaction; but this depends upon the weak saturating power of carbonic acid, and not upon its amount being less than the equivalent quantity. By the best modern chemists, the plan has been adopted of applying the simple saline name to any salt which is neutral in composition, that is, which consists of one equivalent of acid to one of base, without reference to its mode of reaction with test paper.

The mutual decomposition of the salts employed in forming this preparation, would produce, if no loss occurred, a regular carbonate of one equivalent of acid to one of base. In order to account for the production of the sesquicarbonate, it may be supposed that from every three equivalents severally of regular carbonate and of water generated, one equivalent of ammonia and one of water are lost; so that nothing would remain to sublime but the exact ingredients of the hydrated sesquicarbonate. FRANKLIN BACHE.

Effects upon the System. As the medical properties of carbonate of ammonia differ from those of its alkaline base only in degree, it is proposed to consider the general subject of ammonia in its relations to the system under the present head. When, in any case, one of the preparations containing the alkali in its caustic or carbonated state is considered more applicable than the others, it will be particularly designated.

Ammonia is a general stimulant of the vital functions. Taken internally, it produces excitement with a feeling of warmth in the stomach, quickens the motion of the heart and arteries, increases the heat of the skin, elevates the nervous actions, and, if in moderate quantities, augments the various secretions. Its strongest local tendency is to the skin; although, under favourable circumstances, it may be directed with some force to the kidneys or uterus. It differs from the narcotic stimulants in exerting no peculiar influence upon the brain. In large doses it is said to prove emetic. It is a powerful antacid; pure ammonia having a higher neutralizing power than any other alkaline base. It probably acts as a medicine, partly by a direct stimulant impression upon the stomach, which may be sympathetically propagated, partly by entering the circulation and thus coming into contact with all parts of the system. Swallowed in overdoses, it inflames the stomach; and in a concentrated state, acts as a corrosive poison. Death may result either from its immediate disorganizing operation upon the parts with which it comes in contact, or, according to ORFILA, from its influence upon the nervous centres. HUXHAM relates the case of a young man who had

contracted the very singular habit of chewing carbonate of ammonia. Hemorrhage occurred from his nose, mouth, stomach, and bowels; his teeth fell out; and he died in a short time of hectic fever. (*Essay on fevers*, p. 308.) In the case of an epileptic patient, reported by NYSTEN, who was made to inhale ammonia, and had a drachm of the liquid alkali poured into his mouth, violent inflammation supervened in the mouth, throat, œsophagus, and air passages; and death resulted in forty-eight hours, without any convulsive affection, or any obvious cerebral disorder. Dissection exhibited no other morbid phenomena than marks of inflammation in the parts touched by the alkali. (*Gazette de Santé*, 21 Mai, 1816.) A similar case is recorded in the Edinburgh Medical and Surgical Journal (XIV. 642); but no post-mortem examination was made. In the *Revue Médicale* (XVII. 205), an instance is related in which intoxication produced by prussic acid was relieved by the inhalation of ammoniacal vapour, at the expense of a severe inflammation of the mouth, throat, and bronchial tubes, from which, however, the patient recovered in fifteen days. From these facts M. TROUSSEAU has inferred, that the poisonous influence of ammonia is, in general at least, confined to the local irritation which it occasions. (*Dict. de Méd.* II. 385.) The painful impression produced by the alkali, in its concentrated forms, upon the tongue and palate, usually prevents it from being swallowed; so that fatal consequences from its imprudent use are very rare. Two cases have occurred to the author of these remarks, in which the aromatic ammoniated alcohol has been taken undiluted into the mouth with a view to its being swallowed. It was, however, in both instances, immediately discharged; and no other consequences resulted than a severe inflammation of the mouth and throat, which was ultimately relieved. In one instance, a considerable portion of the tongue was denuded of the cuticle. The treatment proper in poisoning by the volatile alkali has been described under the head of *Water of Ammonia.*

Applied to the nostrils, in a diluted state, as it escapes from the materials which produce it, or rises spontaneously from some one of its preparations, ammonia excites a pungent rather agreeable sensation, and produces a stimulant impression, which is felt, to a greater or less degree, throughout the nervous system. The shock thus produced is sometimes so severe, when the vapours are highly concentrated, as to occasion syncope, and even death. An instance of the former effect was witnessed by MERAT and DE LENS; and professor PERCY has related a case of the latter, in which the son of an apothecary perished, notwithstanding the immediate application of remedies, from the breaking of a bottle full of ammonia. (*Dict. de Mat. Méd.* II. 236.) Even when the effects are less immediate, there is danger of violent and fatal inflammation from the inhalation of ammoniacal gas or vapours in a concentrated state.

Upon the skin ammonia acts as a powerful irritant, producing a rubefacient, vesicatory, or caustic effect, according to the strength of the preparation employed, or the length of time during which it is applied.

Those preparations of the volatile alkali in which it exists in the caustic state, as water of ammonia, and ammoniated alcohol, are more powerful in their local effect, but do not act more efficiently as general stimulants, than the carbonate, probably because the pure alkali, when taken into the stomach, is converted into the carbonate before it reaches the circulation. A practical inference from this fact is, that caustic ammonia sufficiently diluted may be used most advantageously as a local irritant or stimulant, and the carbonated alkali, with a view to its influence on the system. In whatever form ammonia is given, its stimulant action is comparatively brief; so that to maintain a given impression, it is necessary to repeat the dose at short intervals.

Therapeutic Applications. Ammonia is susceptible of a great variety of therapeutic applications, and has been very extensively employed. The purpose to which it is best adapted is that of elevating the actions of the system, in states of debility suddenly induced or attending acute diseases. In typhus fever, and in the latter stages of other fevers when they assume the typhoid form, it may be resorted to at an earlier period, and with greater safety, than almost any other stimulant. To these complaints it is peculiarly adapted by its want of any especial action on the brain, as well as by its diaphoretic properties, which obviate that unpleasant heat and dryness of skin so apt to be produced or aggravated by medicines which excite the circulation, without having any tendency to increase the cutaneous secretion.

It may also be given advantageously in the exanthemata, such as small-pox, scarlet fever, and measles, when they assume a low or typhoid form, and require stimulation. In the unpleasant and alarming

condition of these complaints which sometimes attends upon a tardy or repelled eruption, it occasionally proves useful, by bringing on or restoring the affection of the skin; and for this purpose it may be employed more safely than most other stimulants, on account of the comparative brevity of its action, which prevents the injurious continuance of the artificial excitement after reaction has been established.

For precisely the same reason, it is applicable to the prostrate state of the system which sometimes suddenly occurs at the commencement or in the progress of febrile complaints. The indication, in these cases, is usually to bring about reaction with as little prolonged excitement as possible; and the carbonate of ammonia is well calculated to meet this object.

Even the phlegmasiæ, when they degenerate into the typhus condition, may be treated advantageously by this stimulant. In proportion to its ability to elevate the vital powers, it has less tendency than most other substances of its class to increase existing inflammations, unless seated in the parts with which it is brought into immediate contact when administered. Thus it is highly useful in pneumonic inflammations attended with prostration, particularly in that form which is usually known by the name of bilious pneumonia. It may be employed also in typhus dysentery, certain low states of puerperal peritonitis, malignant sore throat, erysipelas and carbuncle attended with enfeebled action, external gangrenous inflammations, and gouty or rheumatic affections accompanied with a cool skin, a feeble pulse, and other signs of general debility.

In all the cases above enumerated, and others of an analogous character, the carbonate is preferable to the other ammoniacal preparations. Care should always be taken in administering it, to graduate the dose to the wants of the system, and to diminish or suspend it, if it should be found to increase the heat and dryness of the skin and frequency of pulse, or to aggravate any existing inflammation. It is usually best, unless in urgent cases, to commence with a small dose—four or five grains, for instance—and gradually increase, as the symptoms may appear to demand, to ten grains or more. The dose should be repeated every hour or two hours, in order to maintain a uniform impression. When no signs of cerebral inflammation exist, the volatile alkali may often be advantageously alternated with wine-whey, which, if taken warm, harmonizes admirably with the ammonia, in supporting the failing powers of the system, and maintaining a warm and moist state of the surface.

The influence of the volatile alkali upon the nervous system has led to its employment as an antispasmodic in various complaints, such as hysteria, epilepsy, tetanus, &c.; but any power which it may possess of allaying convulsive movements, other than such as is connected with its stimulant property, is very feeble; and practitioners at present seldom resort to it with this view. Nevertheless, it has been regarded by some French physicians as one of the most effectual remedies in tetanus, when very largely given—to the amount, for example, of half an ounce daily, in divided doses. (*Dict. de Méd.* II. 389.)

In spasmodic affections of the stomach, unconnected with inflammation, it is cer tainly a valuable remedy. Examples of this kind we have in translated gout and rheumatism, flatulent colic, dyspeptic gastrodynia, and cholera morbus, in all of which ammonia may be used with advantage. In that vague uneasiness of stomach, arising from deficient nervous energy, which is often a distressing accompaniment of dyspepsia, it is also frequently beneficial by its warming and cordial influence. Where the gastric affection is connected with acidity, the alkali is peculiarly useful. Its union of antacid and cordial properties renders it, indeed, a highly valuable remedy in cardialgia, and those various disordered sensations, such as vertigo, deranged vision, and sick head-ache, which depend on the presence of acid in the stomach. When the acid is abundant, the ammonia may be advantageously combined with other alkaline remedies, such as the carbonate of soda, carbonate of potassa, or magnesia. We are told that ammonia is employed, with much success, in the relief of ruminating animals suffering under a gaseous distension of the paunch arising from the extrication of carbonic acid gas. The alkali, in consequence of its strong affinity for carbonic acid, absorbs the gas already extricated, while it suspends the fermentation of the food by which it is produced; and the consequence is the immediate disappearance of the distention. (*Bull. des Sc. Méd. de* Ferussac, Mai, 1826.) It has been suggested that the remedy may sometimes prove serviceable, in a similar manner, in the human subject. In all cases, in which the ammonia is addressed particularly to the stomach, its caustic form is preferable to that of the carbonate; and the most pleasant and elegant preparation is the *Aromatic Ammo-*

niated alcohol of the U. S. Pharmacopœia. This may be given in a dose varying from ten drops to a fluidrachm, largely diluted with water, and repeated more or less frequently, according to the duration and urgency of the symptoms.

As a stimulant diaphoretic, ammonia has been recommended in chronic rheumatism and certain states of palsy, and may no doubt have proved occasionally serviceable in these complaints; but it is at present not much employed in either, except in the form of ammoniated tincture of guaiac, which is often and very beneficially prescribed in rheumatic affections.

Under the impression that it possesses expectorant powers, it has been used in chronic catarrh, the latter stages of whooping cough, humoral asthma, the chronic bronchial affection which succeeds ill-cured measles, and in the declining stage of phthisis. It does not, however, appear to possess any peculiar tendency to act on the pulmonary organs; and if it be productive of good in these complaints, as it occasionally is, when they are complicated with general debility, the result must depend merely on its stimulant operation. It frequently happens, in pectoral complaints of long duration, that the remaining strength of the patient is insufficient to enable him to discharge the mucus or pus which collects in the air-cells and bronchial tubes, and suffocation is the necessary consequence, unless relief is afforded. The volatile alkali, under these circumstances, sometimes proves serviceable by imparting to the muscles concerned in expectoration, sufficient power to throw off the accumulated secretion. In this way it may be the means of saving life in diseases of a curable character, and may afford great relief in the closing scene of some that are incurable.

Ammonia has been recommended internally in amenorrhœa, and may prove useful in the same manner as any other stimulant, by exciting the circulation at a time when the system is predisposed to the menstrual effort, but is, of itself, unable to establish the secretion.

Dr. Neumann, of Berlin, cured a case of diabetes mellitus, which succeeded an attack of ascites in a woman of a feeble and hysterical constitution, by the continued use, for four months, of carbonate of ammonia, given at first in the dose of five grains thrice daily, and afterwards increased to fifty grains in a day. (*Journ. of For. Med. Sc. and Lit.* III. 718.)

High commendation has been bestowed upon the volatile alkali as a remedy in lues venerea; but experience has satisfactorily shown that it has no peculiar anti-syphilitic virtues; and if it sometimes prove useful in the latter stages of the complaint, the effect is to be ascribed to its general cordial influence on a debilitated and depraved condition of the system.

The same may be said of its use in scrofula, in the ulcerated states of which it is asserted to have been beneficially employed. No credence whatever can be attached to the favourable reports of its internal use in cancer.

Some writers speak of the employment of carbonate of ammonia as an emetic, in the dose of thirty grains or more; but its operation in this way must be at best uncertain, and it should never be confided in alone. It is possible that its addition to the ordinary emetic medicines may be useful in certain cases of languid stomach or general debility, in the former by awakening susceptibility to their action, in the latter by counteracting their exhausting influence.

Ammonia has long enjoyed considerable credit as an alexipharmic. It was introduced into notice as an antidote to the poison of venomous serpents, about the year 1747, by Bernard de Jussieu, who believed that he had used it successfully in the case of a student who had been bitten in the hand by a viper. Since that period, numerous reports have been made in its favour in similar cases. Mangili, an Italian author, has reported cases of its success in the bite of the viper. (*Sul veleno della vipera*, 1809.) Sonnini witnessed the cure of a young Indian, bitten by a *serpens echinatus*, by means of the external and internal use of the *eau de luce*, which is an ammoniacal preparation. Writers both in the East and West Indies, have recorded cases of the successful employment of ammonia in the bites of the venomous serpents of those countries. (Chapman, *Elements of Therapeutics*, &c. II. 159.) Dr. Ramsay, of South Carolina, has also recorded cases of its successful use. (Eberle, *Treatise on the Mat. Med.* II. 177.) In the American Journal of the Medical Sciences, (I. 341.) three cases are detailed by Dr. J. Moore, of Mississippi, one of the bite of a rattlesnake, the two others of the bite of a mockasin, which he asserts to be still more venomous than the rattlesnake, in all of which cures were effected by the use of water of ammonia, taken internally, in the dose of a tea-spoon-full repeated in half an hour or an hour, and applied externally to the bite by means of pledgets of lint moistened with it. Dr. Moore speaks also of fourteen other cases

of unequivocal character, which had been treated under his own eye, during a period of twenty years, with similar results. If faith can be attached to medical testimony, it would appear that the volatile alkali really possesses considerable power over that state of system produced by the poison of serpents; although Fontana declares, from his own experience, that it is rather injurious than useful, and cases have been recorded in which it proved wholly inefficacious. It is certain, that of individuals bitten by poisonous serpents, many are but slightly or not at all affected, and others recover without the use of remedies; so that a physician might be led into error by attributing to the medicine effects which would have equally occurred without it; but from the details presented, particularly in the cases recorded by Dr. Moore, it is scarcely possible to resist the inference that the ammonia was the real cause of cure. Negative testimony, unless abundant and various, cannot be admitted as conclusive against statements of positive experience; as the circumstances of the case, and the mode of applying the remedy, may be different. At all events, ammonia is well worth a trial in all cases of the kind alluded to; but it should never be relied on to the exclusion of means calculated to remove the poison at once from the wound, when the opportunity is offered of doing so, before it has begun to affect the system. In all instances it is recommended to combine its local with its internal use.

It is customary also to employ ammonia in the bites of venomous insects, the stings of bees, wasps, hornets, &c.; but these are seldom so severe as seriously to affect the constitution, and the internal use of the remedy is, therefore, in general, unnecessary, while the local injury may usually be treated with greater comfort to the patient by refrigerant than by rubefacient applications. In the horrible disease which results from the bites of rabid animals, ammonia, though recommended by some authors, is altogether inadequate to afford relief.

The use of the volatile alkali as a counter-poison has not been confined to cases resulting from the bites of animals. It has been supposed also to possess the property of counteracting various vegetable poisons, such as prussic acid, alcohol, and ergot. As an antidote to the poisonous effects of prussic acid, it was proposed by Mr. Murray, of London, whose experiments with it upon inferior animals were so satisfactory that he expressed his willingness to take himself a sufficient quantity to destroy life under ordinary circumstances, provided a competent person should be at hand to apply the remedy; but other experimenters have not been equally successful; and no one at present considers the alkali as competent to prevent the fatal effects of the poison. (See *N. Amer. Med. and Surg. Journ.* VIII. 421.) The most that it can do is to afford relief in mild cases; and it is possible that when the struggle between the influence of the acid and the powers of the system is very nearly balanced, ammonia might turn the scale in favour of the latter. Prussic acid acts as a powerful sedative, immediately reducing the vital energies and actions; ammonia, by its stimulant properties, may possibly, in some instances, support life, till the poison has ceased to act. The gas, as it escapes from the watery solution, (aqua ammoniæ of the shops,) may be applied to the nostrils, and inhaled mixed with the atmospheric air into the lungs; and the same solution may be swallowed, sufficiently diluted with water. Care, however, must be taken that the application be not made in sufficient intensity to induce serious inflammation of the air-passages.

There can be no doubt that ammonia possesses the property, to a certain extent, of dissipating the inebriating effects of spirituous liquors. M. Girard, of Lyons, is believed to have first made the fact public; and it has since been confirmed by the observations of other physicians; but the remedy is effectual only in mild cases of drunkenness, and not uniformly in these. It probably acts merely by its excitant influence over the nervous system. Small doses of the water of ammonia, or of the aromatic ammoniated alcohol, may be given at short intervals, in a wine-glass-full of sweetened water.

M. Courhaut believes that he has found in ammonia a certain remedy against the dangerous effects of ergot. He gives the water of ammonia internally, and at the same time applies it to the part threatened with gangrene; and he assures us, that of three hundred patients treated in this way he has lost only one. (*Dict. Univ. de Mat. Med.* I. 241.) The stimulant property of ammonia may render it useful in the disease ascribed to ergot, which is of a typhoid character, as we know it to be useful in ordinary typhus; but the cases of M. Courhaut prove almost too much. They must have been very slight to have been cured in so large a proportion; and the suspicion cannot but arise, that they might have terminated in the same way without the remedy.

Dose and mode of administration. The dose of the carbonate of ammonia is from

five to fifteen grains. It may be given in the form of pill, or in that of aqueous solution, which is preferable. Pills of it may be made with powdered gum arabic and syrup, or with some soft extract, as that of chamomile, and should be dispensed in a wide-mouthed phial, which should be kept well stopped. If put into a box, they would be apt to lose a portion of their strength in consequence of the escape of a part of the ammonia. The solution may be rendered less unpleasant to the taste, and less irritating to the throat when swallowed, by the addition of loaf-sugar, gum arabic, and some aromatic volatile oil. The following formula may be used:—℞. Ammoniæ Carbonatis ʒj; Acaciæ gum. pulv., Sacchar. alb. āā ʒij; Aquæ Menth. Pip. f℥vj; *mist. fiat.* Of this solution a small table-spoon-full contains five grains of the carbonate.

The dose and mode of exhibition of the other preparations of ammonia are stated under the heads of these preparations respectively.

External and Local Use. The uses of ammonia as a local application are scarcely less various than those for which it is internally employed. One of the most common is to produce a stimulant impression upon the nostrils, and, to a certain extent, upon the respiratory organs, in order to relieve nervous languor and faintness, and to rouse from syncope either partial or complete. In slight cases, it is sufficient to employ the common smelling-salts, consisting of carbonate of ammonia scented with some aromatic volatile oil; but when a stronger impression is required, it is necessary to resort to the water of ammonia, or to the ammoniated alcohol. Great success was obtained by Sage in recovering animals from a state of asphyxia, resulting from the inhalation of carbonic acid gas, by means of ammoniacal vapours applied to the interior nares and to the bronchial tubes; and the practice is well worthy of being imitated upon the human subject. The ammonia may act, in this case, not only by its excitant powers, but also by its affinity for the carbonic acid, which it completely neutralizes. But in all instances of syncope or insensibility in which the volatile alkali may be employed as a nasal stimulant, care is requisite not to apply it in too concentrated a state; as dangerous if not fatal inflammation of the nostrils, trachea, and bronchial tubes, may otherwise result. An instance has been already related in this essay, in which death occurred, in an epileptic patient, from the too free application of ammonia during one of his paroxysms.

To the skin, ammonia may be applied as a rubefacient and vesicatory. With a view to the rubefacient effect, it is used in external rheumatic and gouty affections, in local palsy, in chronic indolent tumours to promote their resolution, and in various internal inflammations in their incipient or chronic state, as, to the neck, in inflammation of the throat, and to the chest, in catarrhal complaints, particularly in infants. For these purposes, the water of ammonia is usually employed in connexion with from four to eight times its bulk of olive oil, as in the volatile liniment, or *Linimentum Ammoniæ* of the U. S. Pharmacopœia. This may be applied by rubbing it on the part affected, or by placing upon the part a piece of flannel saturated with the liniment. Caution is requisite not to use the liquid ammonia in too concentrated a state, lest vesication and painful ulceration should be the consequence. Sometimes the ammonia is associated with camphor, as in the *Linimentum Camphoræ Compositum* of the London Pharmacopœia. The carbonate of ammonia is sometimes used for the same purpose, powdered and mixed with three times its weight of extract of belladonna, or other narcotic extract, and then spread upon leather. Such a plaster is peculiarly useful in local pains of a rheumatic or neuralgic character. Another mode in which ammonia is employed as a rubefacient, is in a plaster made by melting together *one ounce of soap* and *two drachms of lead-plaster*, and then adding *half a drachm of muriate of ammonia.* The muriate of ammonia is decomposed by the alkali of the soap, and the ammoniacal gas gradually liberated. The application of the plaster should be renewed every twenty-four hours, in order to maintain a prolonged impression. Dr. Paris states that he has used this plaster with advantage in pulmonary affections, and in rheumatism of the muscles of the chest. (Paris's *Pharmacologia.*)

In cases of great violence or urgency, water of ammonia may sometimes be employed advantageously to excite speedy vesication. For this purpose, it may be used in severe neuralgia, or dangerous spasm of the stomach, or in cases of great and sudden prostration accompanied with insensibility, in which a powerful external impression is demanded. Vesication by means of ammonia may also be resorted to when our object is to obtain very quickly a denuded surface, in order

to apply remedies calculated to affect the constitution through the medium of cutaneous absorption. A piece of flannel saturated with the liquid may be rubbed upon the part until the cuticle is removed; but where sensibility remains, this operation is too painful to be borne, in consequence of the contact of the alkali with the denuded points of surface, during the whole period requisite for the completion of the process. A better plan is usually to form a compress of several thicknesses of linen, or patent lint, of the shape and size of the intended blister; then to saturate this with the strong water of ammonia, and having applied it to the part, to supply the evaporation of the ammonia by fresh additions till vesication results. In this way, a blister may usually be produced in fifteen or twenty minutes. Simply to moisten a piece of paper or linen with the liquid and to apply this to the skin, will often fail, in consequence of the rapid volatilization of the gaseous alkali; and even the plan above mentioned does not always succeed in the time specified. It has been proposed to employ for this purpose a piece of prepared agaric, of which one surface is spongy and will serve to imbibe the liquid ammonia, while the other is smooth and compact, and will tend to prevent the escape of the gas. The French use an ointment prepared by introducing an ounce of lard into a bottle, melting it, and when it is about to congeal, adding an ounce of water of ammonia of the sp. gr. 0.92, then closing the bottle, and agitating briskly till the ingredients are thoroughly mixed. This is called "*pommade ammoniacale de Gondret*," and may be employed either as a rubefacient or vesicatory. In the former case it is rubbed upon the skin diluted with lard, in the latter it is applied in its undiluted state upon a compress. In ten or fifteen minutes after the application of the ointment, occasionally in a shorter time, the cuticle usually rises if the preparation has been properly made. As soon as this happens, the dressing should be removed, as otherwise a superficial eschar may be formed.

Ammonia is sometimes employed externally in order to change the nature of morbid action in the surface to which it is applied. For this purpose it has been used in burns and chilblains, in cancerous and scrofulous ulcers, and in various cutaneous eruptions. It has been employed also to stimulate or cauterize the indolent surface of fistulous ulcers.

M. Lavagna recommends the use of water of ammonia as an injection in amenorrhœa. In fourteen cases he succeeded by this plan in bringing on the menstrual discharge, sometimes in twenty-four hours, and at furthest in five or six days. He employed a mixture of ten or twelve drops of the ammoniacal liquor with a fluid-ounce of warm milk, and repeated the injection several times a day. The practice, however, is not likely to be generally imitated in this country. MM. Merat and De Lens state that they have, in several instances, employed a similar injection, with advantage, in simple leucorrhœa.

Geo. B. Wood.

Bicarbonate of Ammonia.—*Ammoniæ Bicarbonas*, Ph. D. This variety of the carbonate is officinal only with the Dublin College, and is directed to be obtained by saturating the officinal solution of carbonate of ammonia, with carbonic acid gas. The solution obtained is allowed to rest, in order to form crystals, which are to be dried without heat, and kept in a well-stopped bottle. It may be formed also by exposing the sesquicarbonate for a long time to the air; when every two equivalents of the salt may be supposed to lose one equivalent of ammonia.

Properties, &c. Bicarbonate of ammonia is a more permanent salt than the sesquicarbonate, and is much less soluble in water, requiring eight times its weight of that liquid for solution. It has a mild taste, not at all alkaline, and scarcely reacts as an alkali. It possesses, though in an inferior degree, the medicinal virtues of the carbonate; but has the advantage, according to Dr. Barker of Dublin, of affording the practitioner the means of prescribing ammonia in a convenient and palatable form. The dose is from six to twenty-four grains, dissolved in cold water as hot water would decompose it.

Composition. This salt consists of two equivalents of carbonic acid, one of ammonia, and two of water. The composition of the sesquicarbonate has already been given, as three equivalents of acid to two of ammonia. But, besides these two carbonates, a third exists, not used in medicine, which consists of one equivalent of acid to one of base, and which may therefore be called the *regular* carbonate. It is formed when one volume of dry carbonic acid is mixed with two volumes of dry ammonia. This salt cannot exist in solution, for by the action of water it is converted into the sesquicarbonate.

Solution of Acetate of Ammonia.—*Liquor Ammoniæ Acetatis*, Ph. U. S. et L. This solution is most readily formed by saturating either the diluted acetic acid

of the U. S. Ph., or distilled vinegar with carbonate of ammonia. The quantity of the salt necessary to saturate a pint of the acid (sp. gr. 1.009) is within a few grains of seven drachms. The most convenient way of ascertaining the point of saturation, is by the alternate use of litmus and turmeric paper. It is best, however, to allow a slight acidity to prevail; as this will probably arise from the presence of a small portion of carbonic acid, which will be dissipated by time.

Properties. Solution of acetate of ammonia has generally a yellowish colour; but when made of pure materials, it is limpid and nearly colourless. Its taste is saline, and resembles that of a mixture of nitre and sugar. It should not be made in quantities; for, if long kept, its acid becomes decomposed, with generation of a portion of carbonate of ammonia. As formerly prepared under the name of *Spirit of Mindererus*, it was made from the impure carbonate of ammonia, obtained by distilling bones, which contains a portion of empyreumatic animal oil. When thus prepared, it contains a portion of ammoniacal soap, the presence of which, according to Chaussier, increases the tonic and diaphoretic properties of the salt. This solution is incompatible with acids, alkalies whether pure or carbonated, lime-water, magnesia, corrosive sublimate, the sulphates of magnesia, iron, copper, and zinc, and the nitrate of silver. When it contains free carbonic acid, it produces with the acetate and subacetate of lead, a precipitate of carbonate of lead, sometimes erroneously taken for the sulphate of this metal. When the solution is evaporated, one portion of the salt rises with the water, and another abandons its ammonia; and hence it is difficult to obtain this acetate in a crystallized state. It may be obtained in this state, however, by allowing a hot saturated solution to cool in a well-corked phial; or in a solid state, by subliming a mixture of muriate of ammonia, with an equal weight either of dry acetate of potassa or of lime. It consists of one equivalent of acetic acid 51, and one of ammonia, $17 = 68$. When crystallized, it contains seven equivalents of water.

Therapeutical Applications. Solution of acetate of ammonia is a valuable stimulating diaphoretic, which may be often advantageously employed in advanced stages of fevers, particularly when attended with restlessness and want of sleep, According to the particular indications present, it is sometimes combined, with good effect, with nitre and antimonials, camphor, or opium. It is sometimes used externally, as a stimulating application, in cynanche parotidea, and in certain cutaneous eruptions. The dose is from half a fluidounce, to a fluidounce and a half, repeated every three or four hours. It may be conveniently exhibited in febrile cases, mixed with an equal measure of carbonic acid water.

Solution of Hydrosulphate of Ammonia.—*Liquor Ammoniæ Hydrosulphatis*, Ph. U. S.—This preparation is made by saturating water of ammonia with sulphuretted hydrogen, (hydrosulphuric acid gas). It is a liquid of a greenish-yellow colour, very fetid smell, and disagreeable taste. It is characterized by giving coloured precipitates with neutral metallic solutions, for which it is much used as a test. When treated with acids, it is decomposed, with effervescence of hydrosulphuric acid, and deposition of sulphur. As a medicine, it is said to act as a powerful sedative, lessening the action of the heart and arteries, and producing nausea, vomiting, vertigo, and drowsiness. It was introduced into practice by Mr. Cruickshank as a remedy in diabetes mellitus, for the purpose of lessening the morbid appetite which often attends that disease; and it has been used with the same intention by Dr. Rollo and others. The dose is from five to six drops in a tumbler-full of water, repeated several times a day, and gradually increased until giddiness is produced.

Franklin Bache.

AMMONIAC. Ammoniacum, U. S. Ph. *Gum ammoniac.*—*Gomme ammoniaque*, Fr.; *Ammoniak*, Germ.

Origin of Ammoniac. The ammoniacum of the ancients was obtained, according to Pliny and Dioscorides, from Lybia, and is generally supposed, upon the authority of the latter of these writers, to have derived its name from Ammon or Hammon, the Lybian Jupiter, near whose temple, in the desert of Cyrene, the plant producing it was said to grow. Jackson, in his account of Morocco, states that ammoniac is derived from a plant, resembling the European fennel, but much larger, growing in the sandy plains in the interior of that country. It abounds in a milky juice, which oozes out through punctures made by a horned beetle, and hardening by exposure, falls to the ground and mixes with the red earth of the plains. It is collected by the natives, and is much employed in fumigation and as an external application in disease, but is not exported. This may possibly be the ammoniacum of ancient authors; but it is conjectured by Mr.

Don, that the drug was formerly as at present procured exclusively from Persia, and that, coming to Europe through Armenia, it received the name of *Armeniacum*, which was afterwards corrupted into *Ammoniacum* or *Armoniacum*, by which the drug was indifferently called. In support of this derivation, he adduces the fact, that the name of the apricot was sometimes written, by ancient authors, *malum Armoniacum.* There is no satisfactory evidence that any of the ammoniac of commerce is at present procured from Barbary or ancient Lybia, or that the product observed by Jackson in Morocco is identical with the drug now sold in the shops. Much difference of opinion has existed as to the character of the plant which produces the true ammoniac. Chardin, in his travels, speaks of it as very common in Persia. Lemery considered it a *Ferula*, and gave it the name of *F. ammonifera.* Olivier, who travelled in Persia, without reaching the district where the plant is found, also believed it to be a *Ferula*, from information which he received concerning it. Willdenow, however, having sown some seeds picked from a parcel of ammoniac, and succeeded in raising a plant which proved to be an *Heracleum*, concluded that this was the real source of the drug, and gave it accordingly the name of *Heracleum gummiferum.* This plant has, on his authority, been recognized in the British and United States Pharmacopœias. But Willdenow himself admits that he could obtain no gum-resin from it, though he ascribes the fact to the coldness of the climate at Berlin. Subsequently the plant has been ascertained to be identical with the *H. Pyrenaicum* of Sprengel, which is not uncommon in the mountainous regions of Europe, and neither yields any juice when wounded nor possesses any of the sensible properties of ammoniac. The idea, therefore, that it is the source of this gum-resin has been abandoned. From an imperfect specimen of the ammoniac plant, brought to Paris by M. Fontanier, who resided many years in Persia, and visited the district where the drug is collected, MM. Merat and De Lens were induced to return to the former belief that it was a *Ferula*, and considered it properly entitled to the designation given it by Lemery. (*Dict. Univ. de Mat. Méd.*) It appears, however, from a paper recently published by Mr. David Don in the Transactions of the Linnæan Society (Vol. XVI. part iii. p. 599), that all former conjectures were erroneous, and that the plant belongs in fact to a new genus, which he describes under the name of *Dorema.* The specimen from which he drew up his description was procured by Colonel Wright upon the spot where the ammoniac plant abounds, and exhibits positive evidence of its genuineness in the small tears of the gum-resin with which every part of it is covered.

Botanical and Commercial History. The genus *Dorema* belongs to the Linnæan class and order *Pentandria Digynia*, and to the natural order *Umbelliferæ.* [The following essential character is given by Mr. Don:—"*Discus epigynus* cyathiformis. *Achenia* compressa, marginata; *costis* 3 *intermediis* distinctis, filiformibus. *Valleculæ* univittatæ. *Commissura* 4-vittata."] It is closely allied to *Ferula*, but is distinguished by its large cup-shaped epigynous disc, its completely sessile flowers, and its solitary resiniferous canals. The plant is entitled by Mr. Don, *Dorema Ammoniacum.* It has a perennial root, which sends up a cluster of large, petiolate, subbipinnate leaves, and one or more vigorous stems, jointed, branching, and from three to seven feet in height. It grows spontaneously in the Persian provinces of Irak and Fars, and is particularly abundant in the arid plains in the vicinity of the town of Jezd Khast, on the borders of these two provinces. M. Fontanier was informed that it grows also in Khorasan.

The whole plant abounds in a white milky juice, which exudes on the slightest pressure. According to Captain Hart, it is pierced, when in full perfection, in all directions, by innumerable beetles, armed with an anterior and posterior probe, of half an inch in length; and through the punctures thus made, the juice exudes. (*Trans. of the Med. Soc. of Calcutta*, p. 369.) Major Willock, who had opportunities of personal observation, states that the juice exudes chiefly from the principal stems, and either concretes upon them in lumps, or falls to the ground. It is gathered by the villagers in summer or autumn, and sold to the traders, by whom it is conveyed to Bushire upon the Persian Gulf. From this port it is taken partly to India, whence it enters into general commerce; partly up the Red Sea, so as to reach Europe by the route of Alexandria. It is brought to this country chiefly from Calcutta.

Varieties. Ammoniac comes in tears, and in masses. 1. The *tears* are of an irregular form, more or less spherical, of various sizes, from that of a millet-seed to that of a hazel-nut, sometimes separate, sometimes adhering, externally yellowish or brownish-yellow, with occasionally a

tinge of red, internally whitish, opaque or but slightly translucent at the edges, compact, homogeneous, brittle when cold, and breaking with a conchoidal shining fracture. By the heat of the hand they soften and become adhesive. They are often mixed with impurities, particularly with the seeds of the ammoniac plant, from which they may be readily separated by picking them out by the hand.—2. The *masses*, which are often of considerable magnitude, are of a darker colour, and less uniform structure, presenting, when broken, a dirty gray or brownish surface variegated by whitish shining spots, and apparently consisting of the tears embedded in a cementing substance, and frequently mixed with foreign matters, such as seeds, fragments of stems or leaves, and sand or other earths. They are usually softer than the tears, and are sometimes plastic and adhesive at ordinary temperatures.

The tears are preferred for internal use, as they are more readily separated from impurities. The ammoniac in mass may be purified by boiling it with a little water, straining it through a coarse linen or hempen bag, and evaporating by a moderate heat to the proper consistence; or by dissolving it in diluted alcohol, filtering and evaporating. From the coarser impurities it may be separated by powdering it in cold weather, and sifting the powder, which afterwards agglutinates.

It is said that under the name of purified gum-ammoniac, a mixture of this gum-resin with inert substances has sometimes been sold. The remark, however, applies rather to the markets of Europe than of this country.

General properties and composition. The odour of ammoniac is peculiar, somewhat analogous to that of galbanum, and stronger in the mass than in the tears. The taste is nauseous, bitter, slightly sweetish, and somewhat acrid. The specific gravity is 1.207. The gum-resin is brittle and even pulverizable in cold weather, but softens and becomes adhesive with a moderate heat, though it does not melt. It is inflammable, burning with a white flame, and emitting fumes of a strong, resinous, slightly alliaceous odour. It is partially soluble in water, alcohol, ether, vinegar, and alkaline solutions. By trituration with water it forms an opaque milky emulsion, which gradually deposits the resinous portion, and at length becomes clear. The alcoholic solution is transparent, but is rendered milky by the addition of water. Bucholz found in 100 parts of ammoniac, 22.4 parts of gum, 72.0 of resin, 1.6 of bassorin, and 4.0 of water including volatile oil and loss. Braconnot obtained analogous results. Hagen succeeded in procuring the volatile oil separate by repeated distillation with water. It had a penetrating disagreeable odour, and a taste which was mild at first, but afterwards nauseous and bitter. The resin of ammoniac is wholly dissolved by alcohol, and by the fixed and volatile oils, but only partially so by ether, which divides it into two resins, one soluble, the other insoluble in that menstruum.

Effects upon the system. Ammoniac is moderately stimulant and feebly antispasmodic, and possesses the property of exciting, to a greater or less degree, most of the secretory functions. Its action appears to be directed peculiarly to the bronchial mucous membrane, and its influence in producing or facilitating expectoration is that for which it is most valued; but it may also be made to operate as a diaphoretic, diuretic, or emmenagogue, by administering it in suitable combination, and in appropriate conditions of the system, and by employing measures calculated to give its stimulant properties the desired direction. In small doses it produces only a gentle excitement of the stomach; but when freely given, it is apt to occasion gastric heat and uneasiness; and in large doses often purges.

Therapeutic use. Ammoniac has been used as a medicine from the time of Hippocrates. The complaints to which it appears to be best adapted, are chronic affections of the pulmonary organs, in which it acts as a stimulant expectorant, promoting the bronchial secretion when deficient, and restraining it within manageable limits when so copious as to oppress the lungs by its superabundance. It may be given with occasional advantage in chronic catarrh, catarrhus senilis, chronic pneumonia, asthma, the secondary stage of peripneumonia notha, and in the latter stages of phthisis. It should not, however, be employed in cases attended with inflammatory excitement either local or general. From a neglect of this caution, it sometimes produces injury, and Cullen observes that he has frequently found the mischief arising from its heating properties greater than the benefits resulting from its expectorant powers. It has been recommended in hoarseness, and may possibly prove advantageous, in some instances, after all symptoms of acute inflammation have subsided. When given in complaints of the respiratory organs, ammoniac is usually associated with other expectorants, as with squills, assafetida, ipecacuanha, and tartar emetic,

and sometimes with muriate of ammonia, which is supposed to exercise a beneficial influence over diseases of the mucous membranes. Dr. Chapman speaks favourably of a mixture of ammoniac and nitric acid, in cases in which a large accumulation of purulent or viscid matter exists, with feeble and difficult expectoration. The fumes of the gum-resin, resulting from its decomposition by heat, have sometimes been inhaled in cases of chronic catarrh.

It is said that ammoniac is used with advantage to augment the flow of urine in dropsical affections, and to support the salivation in small-pox. (*Edinburgh New Dispensatory*, 1830.) But its diuretic action is too feeble and uncertain to render it a useful remedy in dropsy; and the propriety of employing it to stimulate the salivary glands in variolous diseases is very doubtful, even allowing it to possess the power.

It has been occasionally used in amenorrhœa, and in chlorotic and hysterical affections depending on that disease. Combined with myrrh, aloes, or the chalybeates, it may sometimes add to the efficacy of these medicines, in uterine obstructions; but its virtues as an emmenagogue are very feeble, and it is not often used in this capacity. In atonic leucorrhœa, it is said to have been given with some advantage.

By the older physicians ammoniac was considered as a useful remedy in obstructions of the abdominal viscera, and in the various morbid conditions arising out of such obstructions, as hypochondriasis, dyspepsia, and chlorosis. With this view of its operation, Richter recommends it, combined with assafetida, tartarized antimony, &c., in amaurosis. If it operate usefully in these complaints, it is probably by the revulsion which it establishes towards the alimentary mucous membrane.

Some writers speak in strong terms of its beneficial influence in certain obstinate colics which they suppose to depend upon the presence of a viscid mucus in the bowels. We may admit the fact that spasmodic pains in the bowels are occasionally relieved by ammoniac, without at the same time admitting the supposition as to their cause. The probability is, that this gum-resin affords relief, under such circumstances, in the same manner as assafetida, by its gently excitant and antispasmodic properties.

Ammoniac should not be given when the stomach is inflamed, or much irritated, though symptoms may exist which appear to call for its use. By a neglect of this caution, it has frequently done mischief in pectoral complaints.

Dose and mode of administration. The dose of ammoniac is from five to thirty grains. In pectoral complaints it should be given in small doses, of six or eight grains for instance, repeated three or four times a day, or more frequently, according to the circumstances of the case. In the quantity of twenty grains, or more, it is apt to affect the bowels. It may be given in pill or emulsion. In the former state, it is usually associated with other substances, as with squill, ginger and soap, in the *Pilulæ Scillæ Compositæ* of the London and Dublin Pharmacopœias, and with squill, cardamom, and liquorice in the *Pilulæ Scilliticæ* of the Edinburgh college. The emulsion may be made by rubbing up the ammoniac with water gradually added, with or without the addition of gum arabic. It is frequently called *lac ammoniaci*, from its opaque milky appearance. The proportion of the ingredients in the *Mistura Ammoniaci* of the U. S. Ph. is two drachms of the gum-resin to half a pint of water. The dose of this preparation is about a table-spoon-full. A fluidrachm of strong nitric acid may sometimes be advantageously added to the mixture.

External use. Ammoniac has enjoyed considerable reputation as a discutient application in chronic scrofulous swellings, and other indolent tumours, especially those of the joints. It is employed in the form of a plaster (*Emplastrum Ammoniaci*), which is prepared, according to the U. S. Ph., by dissolving the gum-resin in vinegar, then straining, and evaporating to the proper consistence. It acts by its stimulant property, which is sometimes so considerable as to produce an inflamed papular eruption; and a fatal case of diffuse inflammation resulting from its use in disease of the knee-joint, has been described by the late Dr. Duncan, of Edinburgh. The discutient properties of ammoniac are thought to be increased by associating it with mercury; and a preparation under the name of *Emplastrum Hydrargyri cum Ammoniaco*, is directed by the London and Dublin colleges. The plaster, as prepared by the latter college, is preferable; as the mercury is extinguished by means of turpentine, which adds to its efficacy, instead of by sulphurated oil employed for the same purpose by the London college, which weakens the effect of the mercury by forming with it an inactive sulphuret.

Geo. B. Wood.

AMNESIA. (From α, priv. and μνησις, memory.) A loss or defect of memory.

Memory being intimately connected, if not identical, with those faculties of the mind by which our ideas are acquired or formed, will, of course, vary with the latter, in extent and activity, in different individuals. Entire loss or deficiency of memory, in the strict sense of the term, is extremely rare; when it does occur, it constitutes, necessarily, a state of fatuity, more or less complete. Hence it is met with only in certain cases of idiocy, or associated with the general imbecility of extreme old age. Partial deprivation or defect of memory is, however, very common. In many cases it would appear to be congenital, depending, in all probability, upon an imperfect development of certain portions of the brain. Thus, from the earliest periods of childhood, in numerous instances, a very great difficulty or even utter inability exists to acquire and retain words or numbers, or to recollect persons, places, or events; and this defect or deficiency in the powers of memory often continues throughout life, and cannot be overcome by the utmost degree of application or attention. Frequently, however, the deficiency of memory is produced by a variety of causes to which the individual is subjected during childhood or even at a later period of life. One of the most frequent of these, independently of direct lesions of the brain, is an injudicious system of education, by which the activity of the different intellectual organs is but imperfectly developed, and the harmony which ought to exist between them is in consequence destroyed; or the organs of the mind become exhausted and incapable of performing properly their functions, from the very common error of overloading the memory with too great a variety of subjects at too early a period, or, in other words, before the different parts of the brain have acquired their complete organization and firmness. In after-life, a frequent cause of defective memory is mental inactivity. The power of memory, in common with all the faculties of the intellect, is increased by regular exercise, often to a very surprising extent; while, on the other hand, it is weakened, we might almost say destroyed, when called but seldom into action. A certain degree of attention is essential to the perfection and accuracy of memory; hence, they who exhibit but little application of mind have invariably a defective memory. Too long continued or intense application of the mind is likewise an occasional cause of defective memory. The intellectual organs, in this case, are over-excited, and, from the morbid state into which they are, in consequence, thrown, cannot perform their functions with their usual facility and regularity.

In all those diseases in which the brain is affected either primarily or secondarily, the memory, in common with all the intellectual powers and faculties, is more or less impaired, and often, for a period, entirely suspended. When a partial disorganization of the brain has taken place, the loss of memory is most generally permanent. Occasionally, however, a loss or defect of memory is almost the only morbid symptom under which the patient labours, and it is to these cases that, in pathology, the term Amnesia is ordinarily restricted. Thus, an individual who had previously possessed the most active memory, will suddenly be deprived of its exercise either in relation to words, things, numbers, or places, while in all other respects his intellectual functions are not perceptibly impaired. In other cases, the deprivation of memory occurs more gradually. There is first experienced a considerable difficulty in recalling to the mind a particular idea, or the word or sound by which it is expressed: this difficulty increases every day, until at length it amounts to a total incapability.

Amnesia comes on occasionally without any apparent exciting cause. In many instances it is occasioned by blows or falls upon the head, producing fracture of the skull, or injury of the brain. Most generally, the defect of memory is apparent immediately after the receipt of the injury; but sometimes it is not perceived until after the lapse of several hours, or even days. In a large number of cases, it is after recovering from an attack of apoplexy, or other disease of the brain, that the loss of memory is apparent. One of the most common affections productive of amnesia, is epilepsy, particularly when the paroxysms are very violent and of frequent recurrence.

In investigating the nature and causes of amnesia, we shall be compelled to adopt the opinions of the phrenological school, in relation to memory; that it is not, namely, a distinct faculty of the mind, but one of the general attributes of the different elements of which the intellect is composed; in other words, that memory is the exciting to activity, by the power of the will, the knowing and reflecting faculties of the mind, in consequence of which the ideas those faculties had previously formed or

acquired, are recalled. It is by this explanation alone, that we can account for the difference in the powers of memory possessed by different individuals; for the fact, that in one person the memory shall be peculiarly active in relation to words or numbers, but strikingly deficient in reference to persons or places, and vice versa; or those cases in which the memory of events or dates is entirely lost, while in regard to all other ideas it is as active as ever. It is true that some of the facts connected with the subject of amnesia are totally inexplicable by the phrenological or any other system of mental physiology; it is only by a more numerous collection of accurate observations that we can hope to arrive at the correct pathology of all the varieties of this curious affection.

The most common form of amnesia is a total inability to recall a particular word, or the name of a certain object. Persons so affected lose entirely the recollection of certain words or names, while they can recall with perfect ease all others. M. CUVIER relates the case of an individual who had lost the memory of all substantive nouns, so that in conversation, whenever these should have occurred they were invariably omitted. (ROCHOUX, *Recherches sur l'Apoplexie.*) BOUILLAUD cites an instance in which the memory of substantives and adjectives was destroyed, while there was a perfect integrity of the memory of things. "We know, also," he adds, "that the celebrated Broussonnet, who died of an affection of the brain, was deprived solely of the memory of substantives. (*Traité de l'encéphalite.*) PINEL gives the case of a notary, who, after an attack of apoplexy, forgot his own name, and those of his wife, his children, and his acquaintance. (*Sur l'aliénation mentale.*) A somewhat similar case is related by BOUILLAUD. The father of the late Dr. Watson, Bishop of Landaff, subsequent to an attack of apoplexy, forgot entirely the name of his eldest son, and inquired many times a day the name of the lad that was at college, and yet he was able to repeat correctly hundreds of lines out of classic authors. (*Life of Bishop Watson.*) In a case related by Dr. JACKSON of this city, a sudden congestion of the brain suspended temporarily the memory of words, without any other disorder of the intellect. In this very interesting case, ideas were formed, combined, and compared; those of things, events, and time, recalled without difficulty; but there was a total loss of the faculty of conveying ideas by words, though not by signs; the defect was not confined to spoken language, but also extended to written language. (*American Journ. of Med. Sciences*, III. 272.) Professor DICKSON of Charleston, S. C., relates in the Journal last quoted, (VII. 359), an instance in which there occurred a complete amnesia in relation to names, while the memory of numbers and of things remained perfect. It is somewhat curious, that in this case the patient was deprived of the power of reading words, but not numbers. The attack was produced by a sudden congestion of the brain. In the instance of the notary referred to by PINEL, the patient was rendered incapable of either reading or writing correctly. RUSH notices a case of amnesia occurring in a citizen of Philadelphia, who, in consequence of a slight paralytic disease, forgot the names of all his friends, but could designate them by their ages, which he had previously learned. (*Diseases of the Mind.*) A very uncommon variety of defect of memory is related by Dr. FAHNESTOCK (*Amer. Journ. Med. Sciences*, XI. 413), in which the amnesia was in reference only to proper names; the perception of the patient being at the same time clear, his memory otherwise distinct, his judgment sound, and his business habits unimpaired. In this case the defect was occasioned by a partial congestion of the brain. We have ourselves met with a curious instance of amnesia occurring in a patient suddenly affected with a slight paralysis, in which there was merely an inability to recollect the letters composing the surname of the individual. He could pronounce his full name accurately, but was unable to write or spell, during the continuance of his disease, his surname. A number of examples are given by BOUILLAUD, of individuals who preserved perfectly the memory of persons, beings, events and facts, but who had totally forgotten the names and words by which they were accustomed previously to express their thoughts. (*Recherches Cliniques.*) Similar cases are referred to by other writers.

Amnesia in regard to words presents many strange varieties, all of which it would be impossible for us to describe in the present article. In some instances, one word is substituted invariably for another, or a certain name or idea is invariably expressed in a different language, without apparently the patient being himself always aware of the substitution. Many cases of this kind are on record. Sir ALEXANDER CRICHTON relates one, which occurred in an attorney; who, if he wanted bread, would ask for his boots, and

though enraged when the latter were brought him, would still call out for his boots or shoes. In like manner, if he wanted a tumbler to drink out of, it was a thousand to one but he would call for the ordinary chamber utensil, or, if this were wanted, would call for a tumbler or a dish. (*On mental derangement*, I. 370.) An instance occurred to Dr. CHAILLY (*Archives Générales*, 1828) of an individual who was suddenly attacked by partial congestion of the brain, while playing at the game of *tric-trac*, and lost immediately all recollection of substantive nouns, for which he invariably substituted the words *sonnez* and *six cinq*, terms used in the above game. Dr. RUSH knew a gentleman affected with amnesia, who, when he wished a knife, called for a bushel of wheat. WEPFER relates three instances, in which the patients, all of whom were Germans, called the objects around them only by Latin names.

Many instances are on record in which the memory of things, persons, numbers, or events, was destroyed, while in all other respects the memory was perfect.

Amnesia in relation to localities is of very common occurrence. SAVARY cites an instance in which an individual, after an attack of malignant fever, lost himself in those parts of London with which previously he was perfectly acquainted, and could not recognize even his own dwelling. JOHN HUNTER was suddenly attacked with this species of amnesia, in 1789, while on a visit at the house of a friend. He did not know in what part of the house he was, nor even the name of the street when told him, nor where his own dwelling was; he had no conception of anything existing beyond the room he was in, and yet was perfectly conscious of his loss of memory. He was sensible of impressions of all kinds upon the senses, and hence looked out of the window, although rather dark, to see if he could be made sensible of the situation of the house. The defect of memory went off gradually, and in less than half an hour recollection was perfectly recovered. (HOME'S *life of Hunter*.) GALL knew a bookseller's assistant, who, after recovering from a brain fever, could not again "learn to remember how and where the books in the shop were placed, with which he had been before so well acquainted." (*System of Craniology*, London edition, 1807.) We have ourselves known one or two instances of this kind, in which the individuals, at other times perfectly familiar with the streets, suddenly lost their recollection of localities, and were obliged to inquire in what part of the city they were.

Persons are sometimes suddenly affected with a total inability to recall particular sounds, even those of the most common occurrence. SALMUTH mentions a case in which the patient could not pronounce certain words, but could nevertheless write them. RUSH relates an instance of the loss of the sounds of words, but not of the letters of which they are composed, the patient being obliged to spell every word that he employed to convey his ideas. Some individuals, remarks CALMEIL, lose the faculty of reproducing certain musical tones, and are hence obliged to give up singing.

In some instances there is a complete forgetfulness of events, time, and place, with a perfect recollection of persons and names. RUSH relates cases of this kind.

The most curious form of amnesia is that, in which the memory of all foreign and acquired languages is lost. LOYER-VILLERMAY cites the case of a man who had forgot the French, but could converse fluently in the Piedmontoise. (*Maladies de la mémoire.*) In St. Thomas's hospital, London, a man was admitted some years since, with an affection of the brain, who, as he grew better, spoke in a language which his attendants did not understand. A Welsh milk-woman accidentally going into the ward, heard and conversed with him. It was then ascertained that the patient was a native of Wales, but had left that country in his youth, forgotten his native dialect, and used English entirely for the last thirty years; and that he had now entirely forgotten the English language, and suddenly recovered the Welsh. In HUFELAND'S Journal (*December*, 1828) it is stated that the late Dr. SCHŒRF, a German physician of considerable eminence, on recovering from a severe and dangerous attack of fever, found that he could not recollect a word of Latin, though in other respects his memory was perfect. But after a few days of convalescency, he gradually recovered his knowledge of that language, so that by the time he was perfectly restored to health, he was as good a Latinist as before his attack. Dr. RUSH relates the case of an Italian physician who died in the city of New-York, in 1798, of the yellow fever. In the commencement of his disease he spoke nothing but English, subsequently he could express himself only in French, and on the day of his death he spoke only in his native tongue.

There is sometimes an entire loss of

written language. Bœrhaave notices an instance of this, which occurred in a Spanish tragic author. This person, in consequence of an acute fever, not only forgot all the languages he had formerly learned, but even the alphabet, and was under the necessity of learning again to spell and read. (*Prælectiones Academicæ*, IV.) Dr. Rush also cites the case of a clergyman, in New-Jersey, who, subsequent to an attack of malignant fever, forgot everything he had learned, including the alphabet, and had to commence his education anew. One day, however, whilst repeating his grammar, he suddenly called for a Latin classic he had begun to read previously to his attack, and at that moment all he had learned before revived in his memory.

An entire loss of memory, as we have already remarked, is extremely rare, and is always associated with idiocy: but the memory may be entirely and even permanently lost in relation to a certain series of events, without the patient exhibiting the least defect of intellect in other respects. Thus cases are on record, in which everything that occurred to the patient during one or more days has been entirely forgotten. According to Lucretius, the persons who recovered from the celebrated plague of Athens, lost entirely the recollection of past events, and many for a time knew neither themselves nor their friends. Orfila states that upwards of one hundred and fifty soldiers of the French army, who had eaten of the berries of the Belladonna, became affected with the most alarming symptoms of cerebral disease, and after their recovery none of them preserved the recollection of what had occurred during their illness. (*Toxicologie.*) A female who had given birth to an infant, became affected with disease of the brain, and forgot entirely all that occurred for many months subsequently to her delivery, insisting that the child had been born but a few days. After recovery from a state of complete intoxication, many individuals have not the slightest recollection of what had passed around them during the period of an entire week. Abercrombie relates a highly interesting case of the total loss of memory in reference to a period of nearly twelve years, which occurred in a lady who was greatly reduced by a severe and neglected diarrhœa. She had resided in Edinburgh for nearly twelve years, the recollection of which portion of her life she had entirely lost. Her ideas were consistent with each other, but they referred to things as they stood previous to her coming to that city. (*Diseases of the Brain*, p. 300.)

Many more examples of the various forms of amnesia might be presented. The foregoing, however, are sufficient to illustrate the general proposition, that the memory of a certain class of ideas may be lost, either for a time, or permanently, while the power of the intellect, in all other respects, shall be entirely unaffected.

Symptoms and progress. In many cases, as we have already noticed, the attack of amnesia occurs suddenly, in persons otherwise apparently in perfect health, and as suddenly disappears. Thus many individuals, when their minds are labouring under any unusual excitement, lose entirely the command of language, or are unable to recall a particular phrase, or even some particular word. How frequently do we find persons, who on ordinary occasions express their thoughts with great clearness and fluency, but when called upon to address a public assembly, cannot recall a single idea, or frame the simplest sentence! In all these cases, the amnesia disappears with the emotion of the mind which produced it. In general, the attack of amnesia is preceded by pain of the head, particularly of the forehead, as Wepfer long since remarked: this pain, which is noticed in nearly all the cases on record, is accompanied ordinarily with more or less defect of vision, dullness of intellect, and the other symptoms of cerebral congestion. In other instances, the defect of memory is more gradually developed; the patients are then generally the first to perceive it, and point it out to their physician; though cases are on record, in which the individuals labouring under amnesia were totally unconscious of its existence.

When the defect of memory has been produced by an injury inflicted upon the brain, or is the consequence of some severe affection of that organ, it is often, not until after the patient has become convalescent, that it is observed. In chronic affections of the brain, terminating even in partial disorganization of its substance, the amnesia may constitute, for a considerable time, the most prominent, almost the only symptom of disease.

The progress of all the varieties of amnesia is of course variable, depending entirely upon the nature and extent of the lesion of the brain upon which they depend. When the brain is affected simply with partial irritation and congestion, the amnesia may cease spontaneously within a few days or even hours; in other cases it

may endure for weeks, and when disorganization of the brain has taken place, for the remainder of life. In some instances, the amnesia has assumed a remittent form. In the Transactions of the Academy of Sciences of Paris, is the case of a young man who was deprived of memory during the heats of summer, and regained it again when the cool weather set in; and it is stated of Milton that his memory was far less active in warm than in cold weather. When dependent upon an acute affection of the brain, the amnesia, in general, disappears with the symptoms of the latter, or as the mind and body of the patient regain their ordinary vigour. In those cases which succeed to an attack of apoplexy or paralysis, the memory is frequently completely restored, as the blood effused in the brain becomes absorbed, and the cicatrization of the ruptured fibres of the brain is effected. In many instances the amnesia disappears even though the paralytic affection of the limbs remains permanent.

Exciting causes. The exciting causes of amnesia are all those circumstances which, directly or indirectly, produce irritation and congestion, or inflammation and disorganization of the brain. Hence, it has been found to follow blows or falls upon the head, and wounds of the brain. Cases of this kind are related by MORGAGNI, CALMEIL, and by nearly all the surgical writers. Baron LARREY, in particular, has recorded in his surgical memoirs, numerous instances of wounds from swords or bayonets, penetrating the brain, through the orbits, in which the memory for words was lost, but not that of things. Amnesia has, also, been produced by excessive application of the mind, violent paroxysms of anger, inordinate grief, and the other depressing passions. It has also been frequently brought on by a vicious course of life, particularly excess in venereal pleasures. One of the most common causes of amnesia is, perhaps, the unnatural excitement of the genital organs in youth. We have attended, remarks CALMEIL, many young persons, who had, in the commencement of their studies, manifested the most happy dispositions, but in whom the memory became soon impaired, in consequence of the practice of onanism, and other species of debauchery. (*Dict. de Méd.* Art. *Amnesie.*)

The suppression of the hæmorrhoidal flux, of the menstrual discharge, or of any habitual evacuation from the body, by producing congestion of the brain, frequently gives rise to amnesia, which often disappears the moment these discharges are re-established. Exposure to intense cold, or to excessive heat, over-fatigue, intemperance in eating and drinking, or the habitual use of intoxicating drinks, are likewise frequent exciting causes of amnesia. Certain poisons, as opium, cicuta, belladonna, hyosciamus, and stramonium, very generally produce a deprivation of memory. CALMEIL states that he has frequently found the immoderate use of mercury to produce a similar effect. Profuse hemorrhages, or excessive evacuations of blood, as well as profuse and long-continued diarrhœas, the want of food, or the use of that of an unwholesome quality, have likewise been known to produce a very marked diminution of the power of the memory.

Autopsic appearances. The autopsic appear nces in the brains of those who have d ed whilst labouring under amnesia, have been extremely various. As in case of other diseases, the symptoms of which, during the life of the patient, have indicated a very considerable derangement in the functions of the brain, subsequent to death no morbid appearance could be detected sufficient to account for the defect of memory; the irritation and congestion giving rise to it having, in all probability, ceased with the life of the organ. In the greater number of instances, however, effusions of blood were discovered in the brain, or softening of its substance, or various abnormal productions, especially in the substance of the cerebrum.

Pathology. Amnesia has, by some writers, been styled a paralysis of the organ of memory, and by others partial apoplexy. But neither of these propositions conveys any definite idea as to the seat or nature of the lesion by which the deprivation of the memory is produced.

That amnesia is caused by a lesion of some portion of the brain, is rendered evident as well by the particular circumstances under which it occurs, as by the phenomena which ordinarily accompany it, and the appearances discovered in the bodies of those who have died whilst labouring under this affection. As in the case of apoplexy, the morbid condition of the brain may consist simply in a state of irritation and congestion, or of more or less complete disorganization of its substance; the difference in the extent and seat of the congestion or disorganization giving rise in one case to a complete suspension of all the intellectual and sentient faculties, and in the other to a loss of memory only. The fact

is, that in a large number of the cases of amnesia, the defect of memory occurred subsequently to an apoplectic attack.

If we admit, with SPURZHEIM and his adherents, that the memory of each series of ideas formed by the intellect is distinct, and dependent upon the activity of different organs, it must be evident that the affections of the brain giving rise to an amnesia in relation to events, or persons, must be differently seated from that which gives rise to an amnesia in relation to numbers, words, or localities. This fact, however, has as yet not been demonstrated by a sufficient number of accurate observations, to permit us to draw any positive conclusions in regard to it. But, it has been attempted to be shown, by the history of numerous cases, as well as by the result of post-mortem examinations, that all the varieties of amnesia depend upon disease of the anterior lobes of the cerebrum, and it is in this portion of the brain that, according to SPURZHEIM, all the organs upon the activity of which memory depends, are seated. M. BOUILLAUD, in particular, has collected a number of interesting facts and dissections, which prove, as he conceives, that it is upon a lesion of those portions of the brain which are situated immediately behind the orbits of the eyes, that the loss of memory in relation to words, or the general signs by which we express our ideas, depends. (*Recherches Cliniques.*)

CALMEIL, (*Dict. de Méd.*) on the other hand, states that he has met with numerous cases of an almost total loss of memory, in which the anterior lobes of the cerebrum were found unaffected after death, the disease of the brain being seated at a distance from the frontal regions: and a similar statement is made by other writers. Negative cases, such as those just referred to, appear to us, however, to prove nothing more than that amnesia may occur without an actual disorganization of the anterior lobes of the brain. We do not conceive it to be necessary, in order to prove the position advanced by BOUILLAUD and others, that a diseased state of the anterior lobes of the cerebrum should invariably exist after death. They may be affected during the life of the patient, sympathetically, from disease of other parts of the brain, and the irritation and congestion thus produced may disappear with the cessation of life. We know, that in some of the most marked attacks of an apoplectic character, no disease whatever of the brain has been detected after death; but would any one infer from this that the brain had not been morbidly affected during the life of the patient, or that the intellect and consciousness were destroyed without the organs upon which these faculties depend having deviated from their healthy condition?

There is, nevertheless, a very considerable difficulty in explaining many of the forms of amnesia, even admitting that the principles of mental physiology adopted by the followers of GALL and SPURZHEIM, are true to their fullest extent, unless we are prepared to admit a distinct organ for the formation and memory of almost every distinct idea. Thus, as we have already shown, one individual will lose the memory of substances only, another of adjectives, another of proper names; while in other instances, it is only a particular name, word, or phrase, which the person affected finds it impossible to recall to his recollection. M. BOUILLAUD has, it is true, attempted to solve this difficulty. To explain these curious facts, he remarks, we must necessarily admit that the cerebral organ appropriated to articulate language, is composed itself of many distinct parts, each one of which presides over the formation and memory of a different class of the words which constitute language. In other words, that different portions of the organ of language are appropriated to nouns, adjectives, verbs, and so on, and that each of these portions may become diseased independently of the others. (*Traité de l'Encéphalite*, p. 289.) But not only will we have to admit with BOUILLAUD, this subdivision of the organ of articulate language, if we receive his explanation as correct, but we must go farther, and suppose an organ, or portion of an organ, for the words of every language which an individual is capable of acquiring; for we have seen, that amnesia may extend to one or more languages, while in regard to others the memory is as perfect as ever. It is not, however, our intention to enter, in the present article, upon an examination of the true physiology of memory; much in relation to it is still involved in obscurity, and requires for its elucidation a far more extended series of observation than we now possess. In the present state of our knowledge, it is even difficult, if not impossible, to estimate correctly the manner in which the memory is deranged by those lesions that have been detected after death, in subjects who have laboured under amnesia.

The only conclusions that would appear to be clearly deducible from the facts on record are, 1st. That whenever the cerebrum, particularly its anterior lobes, is the

seat of irritation and congestion, or of inflammation, the memory is altered to a greater or less extent, frequently entirely suspended, and is again restored to its normal condition when the morbid state of the brain is removed. 2d. When particular portions of the brain become disorganized, or the seat of any permanent lesion, the memory is impaired or completely destroyed, and is then incapable of being re-established.

Treatment. The proper treatment of amnesia will depend entirely upon the state of the brain, pointed out by the particular phenomena accompanying each case: it will be unnecessary, therefore, to consider it in detail in the present article.

The abstraction, as far as possible, of all the remote and exciting causes that may be presumed to have given rise to the affection, is all-important in every case, and with a properly regulated diet and regimen, will often be sufficient to restore the powers of the memory, even when, for a time, they have been completely lost.

In the majority of instances in which the loss of memory occurs suddenly, in persons otherwise in perfect health, it will be found by an attentive examination of the concomitant symptoms, that a partial congestion of the brain has taken place. In such cases, bleeding, either general or local, or both, according to circumstances, will be demanded, together with purgatives, cold applications to the head, counter-irritants to the extremities, perfect quietude of mind and body, and a very restricted diet.

When the amnesia is perceived in the stage of convalescency from apoplexy or acute affections of the brain, great advantage will be derived from blisters or an issue at the nape of the neck, cold spongings of the scalp, and frictions of the surface generally. Care should be taken, also, not too soon to excite or fatigue the mind by intellectual labours of any kind, or by the ordinary cares of business. When the patient's strength is sufficiently recovered, a short journey will often be decidedly beneficial.

Where disorganization has taken place in the brain, the amnesia, in the majority of cases, will remain during the life of the patient.

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D. F. Condie.

AMNIOS, or AMNION. The internal membrane of the fœtal envelope. See *Ovum.* I. H.

AMNIOTIC. Appertaining to the Amnios.

Amniotic fluid, liquor amnii, the fluid contained in the amnios, vulgarly termed the waters. See *Ovum.*

Amniotic acid. See *Allantoic acid.*

I. H.

AMOMUM. (*Botany.*)

Sex. Syst. Monandria Monogynia. *Nat. Ord.* Scitamineæ.

Gen. Ch. *Corol.* with interior border unilabiate. *Anther* double, with an entire or lobate crest. *Caps.* 3-celled, 3-valved. *Seeds* many, arilled. Roxburgh.

Much confusion and uncertainty has existed as respects the characters of the genera composing the natural order of the Scitamineæ, and more particularly with regard to the genus under consideration. As left by Linnæus the genus *Amomum* included a variety of plants which later researches have shown to possess very different characteristics, and hence have been assumed as types of distinct genera. (See *Alpinia, Zinziber,* &c.) The genus, as now limited by Roscoe and Roxburgh, is a very natural one, and includes many plants peculiar to tropical climates, furnishing aromatic seeds which are in general use among the inhabitants as condiments, and are also recognized in our Pharmacopœias as useful stimulants and adjuvants.

Although most of the ancient writers on the materia medica speak at some length of *Amomums,* it is by no means certain that they alluded to the plants now known under this name: those, however, who are desirous of judging for themselves on this point, may consult Theophrastus. IX. 7., Dioscorides, I. 14., and Pliny, XII. 13.

Among the species which furnish aromatic seeds analogous to the true Cardamoms, and which are used as substitutes for them, the following are the most remarkable, and require notice, as tending

to elucidate the history of the different kinds of Cardomoms of commerce. (See *Cardamoms.*)

1. *A. cardamomum*, Linnæus. *Cardamomum minus*, Rumphius. Amboy. V. 65.

Sp. Ch. Leaves short-petioled, lanceolate. Spikes half immersed in the earth, loosely imbricated, with villous, lanceolate, acute, one-flowered bractes. Lip with the anterior margin three-lobed. Roxburgh. This species, which is a native of Sumatra and other Indian islands, furnishes seeds which approach very closely in most particulars to the lesser or true Cardamoms, and are used as a substitute for them by the Malays.

2. *A. angustifolium*, Linnæus.

Sp. Ch. Leaves broad, lanceolate. Spikes elevated, linear-oblong, compact, elevate; bractes oblong, rather pointed. Lip obovate, cuneate, entire. Roxburgh. This species is a native of Madagascar, and is considered by some writers to furnish the Grains of Paradise, though these are generally attributed to the *A. grana Paradisi*, Linn. It would appear, however, that the plant described by him under that name was the *Elletari* 2. of Rheede. Hort. Malabar, XI. t. 6., which Lamarck has made a variety of his *A. racemosum.*

Besides these species, there are many others which afford analogous seeds. Thus, the *A. aromaticum*, Roxburgh, found on the eastern frontiers of Bengal, where it is known by the name of *Morung elachi*, furnishes seeds which are used as substitutes for the true cardamoms, as are also those of the *A. maximum*, Roxburgh. (See *Cardamoms.*)

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R. E. Griffith.

AMPHIARTHROSIS. (From αμφι, both, and αρθρωσις, an articulation.) This term was devised by Winslow, to designate certain articulations, in which the articulating surfaces are not in immediate contact, but connected by a more or less flexible and very strong intermediate substance, admitting of but limited motion. Such are the articulations of the bodies of the vertebræ with one another. This term has been differently applied by subsequent anatomists, but as it is rarely used at present, there appears no necessity for our occupying any space in investigating the precise meaning in which it has been employed.

I. H.

AMPUTATION. (From *Amputare*, which means literally to cut or lop off a part which is superfluous.) *Amputatio*, Lat. This term has been employed by surgeons to designate the operation by which a member, or a part of a member, is removed, either for the purpose of saving the life of the individual, or of liberating him from the suffering and inconvenience to which the limb exposes him. Amputations are generally performed upon the extremities, but may likewise be executed upon the trunk of the body. This latter operation, however, is generally designated by the term *Extirpation*, (q. v.), while the term Amputation is restricted to the operation by which we remove the extremities by means of cutting instruments. *Excision*, and *Resection*, which have an analogous signification, must not be confounded with the term Amputation, inasmuch as it will be seen by a reference to those words, that they are employed to designate very different objects.

Amputations may be divided according as they are performed upon the *continuity* or in the *contiguity* of the bones; the operation in the first case being carried through the shaft or the substance of the bone, and in the second between their articulating extremities. They are, moreover, differently performed, according to the nature of the member, the character of the disease, or the predilection of the surgeon. Sometimes the member is removed by what is called the circular incision, sometimes by a single or double flap, and occasionally by a combination of these two methods. Each of these plans will have its advantages in particular cases, but in some instances either may be employed, according to the choice or predilection of the operator.

§ 1. *History of Amputation.* Surgeons were doubtless directed originally to the removal of a limb by amputation, from observing the manner in which nature effects the spontaneous separation of a member when affected with gangrene and sphacelus. This remark is made, in fact, by the author of one of the treatises attributed to Hippocrates (*de Articul.* p. 831. *Sprengel*). This writer states, that the greatest danger the surgeon has to apprehend from the removal of a limb, is the alarming hemorrhage which is liable to ensue from the division of the vessels. Celsus

(Lib. VII. cap. 33.) is the first author who has described the method of performing the operation. He directed the parts to be divided between the dead and living structures down to the bone, but in such a manner as to include a small portion of the living parts: the flesh then to be separated to a small extent from the bone, and the operation to be completed by sawing through the latter, a little above the level of the incision, so as to leave a sufficient quantity of the soft parts to be drawn over the face of the stump. To arrest the hemorrhage, he directed a sponge, saturated with vinegar, to be bound upon the face of the stump. It is a little extraordinary that he did not employ ligatures for this purpose, inasmuch as he was in the habit of resorting to them to arrest hemorrhage in other operations. ARCHIGENES commenced the operation by the application of a tight ligature or bandage to the member, for the purpose of preventing the flow of blood. He also sprinkled the limb with cold water, and, according to some, applied ligatures to the vessels themselves. This being done, he drew the integuments upwards, and confined them there while he divided the soft parts and the bone, and then cauterized the whole face of the stump with a red-hot iron, to prevent hemorrhage. He afterwards removed the band or ligature, and dressed the part with a double compress dipped in a mixture of salt and garlic, and subsequently with oil and cerate. Nearly the same plan was recommended by HELIODORUS, who, as well as CELSUS, reprobated the practice of amputating through the articulations, so strongly advocated by GALEN on account of the facility of its execution. PAULUS ÆGINETA condemned the practice advised by CELSUS of dividing the sound parts, but recommended that the incision should be made in their vicinity. He, however, as well as ÆTIUS and AVICENNA, applied the actual cautery to the face of the stump. The Arabians trusted the separation of the member to the operations of nature, and relied upon *Armenian bole* and other styptics to command the hemorrhage. ALBUCASIS practised the operation by dividing the soft parts with a red-hot knife, and promoting the separation of the eschar by the application of the balsam of sulphur,—a method which was subsequently adopted by FABRICIUS HILDANUS. THEODORIC DE CERVIA employed the method of CELSUS; but with a view of diminishing the sufferings of the patient, he administered a large dose of opium and hyosciamus before the operation. GUY DE CHAULIAC, however, was opposed to every mode of amputation, and contented himself with enveloping the diseased member in plasters of pitch, which were drawn so tight as to give rise to a sloughing of the member, in which state it was suffered to remain until it was separated by the efforts of nature. HANS DE GERSDORF employed the method of CELSUS, but after removing the member, he drew a hog's bladder over the face of the stump, instead of resorting to the actual cautery. BARTHELEMY MAGGI introduced an important improvement in the operation of amputation, by adopting the precaution to preserve a sufficient quantity of integuments to cover the face of the stump. FABRICIUS AB AQUAPENDENTE, actuated by the dread of hemorrhage, made his incision through the dead parts: FALLOPIUS resorted to the actual cautery, to arrest the flow of blood; and it was not until the time of AMBROSE PARÉ that the ligature was employed for that purpose. To secure the bleeding vessels this last named surgeon used a curved triangular needle armed with a ligature, which was made to include the parts from which the blood flowed. Many surgeons, however, objected to this plan, on account of the pain it inflicts; and notwithstanding its important advantages, PIERRE, PIGRAI, PLAZZONI, and ROSSI, continued to resort to the actual cautery. BOTALLUS recommended a plan which is only remarkable for its cruelty. It consisted in the use of a kind of machine, formed of a broad sharp hatchet, rendered sufficiently heavy by the addition of lead to cut through the member, on being suffered to fall upon it from a height. This method was also commended by VAN HOORNE, for the amputation of bones affected with *spina ventosa*.

WISEMAN applied a tight bandage around the member, about two inches above the line of separation between the dead and living parts, and while the integuments were drawn upwards, he divided the soft parts with a falciform knife, down to the bone. He then detached the periostium to a small extent with the back of the knife, and sawed the bone in the usual manner. To command the hemorrhage, he employed the ligatures of PARÉ, and then brought the integuments over the face of the stump, and confined them there by means of sutures and strips of an adhesive character, disposed in form of a cross. He condemned the actual cautery, and the red-hot knife; but to maintain the dressings properly ad-

justed, he drew a bladder over the extremity of the stump, and confined it there by several turns of a roller.

The invention of the tourniquet, by MOREL, in 1674, constitutes an important epoch in the history of the operation of amputation. Surgeons had been previously obliged to trust to the constricting force of the bandage to command the flow of blood during the operation; but the instrument of MOREL now furnished them with a much more secure and convenient method of accomplishing that purpose. It was accordingly very generally adopted, and, with various modifications, still continues to be employed by most operators.

It will be seen from what has been stated, that a majority of even the ancient surgeons were anxious to preserve a sufficient quantity of the soft parts to cover the face of the stump; but LOWDHAM was the first, who, more effectually to accomplish this object, recommended that the incision should be made obliquely from below upwards, so as to form a flap of the necessary extent to cover the end of the bone. He may therefore be considered as the originator of the flap operation, which has since been variously modified by VERDUIN, SABOURIN, GARENGEOT, RAVATON, LE DRAN, VERMALE, O'HALLORAN, WHITE, POTT, DESAULT, LARREY, LANGENBECK, KLEIN, RUST, TEXTOR, GUTHRIE, ROUX, LISFRANC, DUPUYTREN, SYME, LISTON, MAINGAULT, MOTT, and others. The operation by the single circular incision, which was originally recommended by CELSUS, has also been submitted to various modifications, by which its advantages have been very much increased. CHESELDEN and PETIT, instead of accomplishing the division of the whole of the soft parts by a single incision carried directly down to the bone, divided this stage of the operation into two acts. During the first, they divided the superficial parts, which were drawn forcibly upwards; the deep-seated parts, consisting of the muscles, were divided by a second incision. Others, with a view of securing a better covering for the stump, have submitted this part of the operation to a variety of modifications. GOOCH, B. BELL, CALLISEN, BOYER, DUPUYTREN, HEY, and a majority of modern surgeons, divide the soft parts by three circular incisions; the first of which is carried merely through the skin and integuments, the second through the muscles, and the third through the structures immediately surrounding the bone, while these parts are forcibly drawn upwards by an assistant. RICHTER even recommended four circular incisions to be practised; but LOUIS and DESAULT accomplished the same object by means of two incisions; one carried through the integuments and superficial muscles, and the other through the deep-seated muscles, down to the bone. ALANSON also proposed an important improvement in the method of amputating. After dividing the integuments by a circular incision while drawn forcibly upwards by an assistant, he dissected up the cellular tissue with the point of his knife, until he had secured a sufficient quantity of skin. With the edge of his knife directed obliquely upwards, he then cut down to the bone in the same direction, and making the point of the instrument revolve round the bone, while its edge was maintained in the original position, with a bold circular sweep he achieved the division of the whole of the muscles, in such a manner, that when the bone was sawed through, the face of the stump represented a hollow cone, the apex of which was directed upwards. But while the method of operating proposed by ALANSON is fraught with difficulties which are almost insurmountable, the object he proposed by it of gaining a flap of sufficient extent, may be easily attained by various procedures which have been adopted in modern times, and which have doubtless been founded upon the proposition originally made by him.

§ 2. *Circumstances which require the operation of Amputation.*

Amputation may justly be considered one of the most desperate resources of the surgeon. In most other cases, the numerous means furnished by his art enable him to restore the suffering organs to health; but in the conditions requiring amputation, there is either such an injury of the living structures, or such an aggression committed upon the vital powers, as to render it indispensable to sacrifice the diseased member to obviate the inevitable destruction of the patient's life. It therefore becomes a matter of the utmost consequence to determine, as far as practicable, those cases which call for this appalling and desperate resort, and to distinguish those in which the life of the individual and the enjoyment of the use of his members, may be preserved without resorting to such a formidable alternative. The rapid improvements which have taken place within the last half century have fortunately reduced, in a remarkable degree, the number of cases which require amputation; yet with all these advances, we have still to regret

that the imperfection of the art continues to render it necessary to practise that operation under a great variety of circumstances. Future observation will, doubtless, diminish still further the cases which now oblige us to resort to such an expedient; yet it is too much to be feared, that there will always be conditions which cannot be remedied by any other course of procedure. In the present state of our knowledge, all that we can do, in considering the cases which require amputation, will be, to lay down certain general principles, to which many exceptions must of course arise, in particular cases, and under peculiar circumstances.

With regard to the precise cases which call for the sacrifice of a member, there has ever existed considerable difference of opinion, some restricting the operation to so small a circle of cases, as almost to exclude it from the resources of the surgeon, while others, swayed by false judgment, or actuated by an overweening desire to enjoy the eclat of operating, have often resorted to it, when the exigencies of the case did not require it to be adopted. Of the first class, were Faure, Gervaise, Bouchard, Dionis, Salchow, Schmucker, but above all Bilguer, who carried his objections against amputation so far as scarcely to admit of its being practised in any case. The views of this last named surgeon were strongly combated by many of his contemporaries; and subsequent experience has fully demonstrated, that many valuable lives may be saved, which would inevitably be sacrificed by an adoption of his principles. But in making this assertion, we would by no means be understood as wishing to hold out any justification of those who resort too frequently to the operation, in cases which do not require its performance.

The following may be considered as a fair expression of the indications which require amputation. When an individual is affected with a disease or injury of a member, which, in the present state of the science, is incurable, or which is rendered so, either by the fault of his constitution, or the circumstances in which he is placed, and which at the same time endangers his safety, or will, by its nature, render him a cripple for life, the removal of the part, by an operation, will be called for. (Rust, *Handbuch der Chirurgie*, I. 538. Berlin, 1830.)

We shall therefore proceed to speak of some of these conditions.

A. *Of Gangrene and Sphacelus.* Although gangrene and sphacelus were formerly considered as the only conditions that rendered amputation necessary, there are many cases in which the members are extensively involved by them, which do well without the operation. It has, indeed, been affirmed by many distinguished surgeons, that mortification, abstractedly considered, can never call for amputation, they alleging that the system is capable, in a majority of cases, of liberating itself of the disease, and repairing the injury inflicted by it; and where such capability does not exist, that, as amputation cannot remove the cause of the malady, no advantage can accrue from resorting to it, but that by its performance we inflict upon the patient a painful and hazardous mutilation of his members, without securing to him any corresponding benefit. There are, however, many cases of gangrene and sphacelus in which amputation will not only be advisable, but constitute the only means of safety; and we are only surprised to find individuals so distinguished in the annals of modern surgery as Rust and Kluge, either forbidding the operation under such circumstances, or restricting its application to so small a number of cases as greatly to limit its usefulness.

When the mortification is of limited extent;—when it is confined to the superficial parts, or, extending profoundly, does not implicate the important blood-vessels and nerves which are essential to the preservation of the integrity of the vitality of the member, the operation cannot be necessary; but the powers of the system, assisted by the skilful co-operation of the surgeon, will be adequate to accomplish a cure without the sacrifice of the part. But should the energy of the system be too feeble to bear up under the aggressions committed upon it, or the recuperative powers inadequate to ward off the ravages of destruction, a timely removal of the member by amputation will be essential to the safety of the patient, inasmuch as, if the case be left to run its course, the system will sink under the influence of the irritation. This course will also be necessary, where the principal vessels and nerves of a member have been destroyed, and consequently where it cannot receive a sufficient supply of blood and nervous influence, to maintain the integrity of its nutritive acts. Nor is the cause by which the mortification is produced, without its importance in deciding upon the propriety of resorting to the operation. An axiom for a long time prevailed upon this subject, which interdicted the interference of the surgeon in all cases of morti-

fication while the disease continues to progress, and only allowed the operation to be practised after the establishment of a distinct line of demarcation between the dead and the living parts. This rule of practice, which was strongly inculcated by SHARP, POTT, and others, has had many zealous advocates, and is still espoused by surgeons of respectability. The extensive experience, however, of numerous military and hospital surgeons, has shown, that it ought not to be adopted without considerable hesitation. Should the death of the part proceed from an ossification or obliteration of an important vessel,—from some perverted condition of the vital powers of the system, the influence of some disease involving many of the functions essential to life, or from the ingestion of some deleterious agent, amputation cannot, of course, correct or remove the cause from which the mischief proceeds, but if performed before the progress of the destructive process has been arrested, can only inflict unnecessary suffering upon the patient, and after all expose him to a re-development and perpetuation of the disease. The constitution being in fault, the amputation of the member will merely be a removal of the effect, the cause still continuing to operate. In such cases, the surgeon should content himself with instituting such general and local treatment as will be best suited to the deranged condition of the organic operations, and endeavour thereby to exalt the conservative powers of the system to that degree of energy, which will enable them to arrest the march of destruction, and set up an effectual barrier against the further progress of the disease. While it continues to advance, he ought not to think of operating, but should patiently wait the development of a line of demarcation between the dead and living parts,—an event which proclaims that the powers of life have sufficiently rallied to provide for their own preservation, and the operation is now only called for, to remove a source of irritation, which, if the cure were left to the tardy process by which the suffering organs seek to relieve themselves, would wear down the energies of the system, and jeopardize the life of the individual,—or it is resorted to for the purpose of obviating the deformity which is frequently apt to arise from the procedure by which the parts are separated, when left to their own resources. In this form of gangrene, therefore, which has been denominated Idiopathic, or constitutional, the establishment of a line of demarcation between the part deprived of its vitality, and that still alive, affords the only signal for the operation; and the question whether it should be performed, must be determined by the extent of the disease, the parts it involves, and the possibility or impossibility of saving the member without endangering the life of the patient. If a large extent of the soft parts, together with the important vessels and nerves, have been destroyed, and the bone is denuded for some distance, amputation will be indispensable; it will also be necessary when the mortification is less extensive, provided the powers of the system are too feeble to enable them to cast off the part which has become deprived of its vitality. In extensive traumatic gangrene, or that form of the disease proceeding from injury, if it be attended with an extensive destruction of the soft parts, either from the diseased process itself, or from the preceding injury;—if it has been occasioned by a contusion or laceration with a simultaneous compound or comminuted fracture of the bone, amputation should be early resorted to, although the disease may still be progressive; ample experience having demonstrated, that, under these circumstances, it will not be proper to delay until the establishment of a well-defined line of separation between the dead and living structures indicates the arrest of the disease. It is under these circumstances that it has been found necessary to depart from the old axiom, adverted to above, which interdicted the operation while the gangrene is progressive. The experience of DERANTE, LARREY, and KIRKLAND, long since led them to question the correctness of this rule of practice, and to amputate in traumatic gangrene while the disease was progressive; and the advantages and necessities of this course of procedure have been fully confirmed by the subsequent observations of LARREY himself, and by the experience of GUTHRIE, LANGENBECK, CHELIUS, HENNEN, LAWRENCE, HUTCHINSON, WAGNER, BUSCH, and others. Indeed, if we were to delay in such cases for the limitation of the gangrene, we should find, that in many instances, no such limitation would be developed, and the disease would advance with rapid strides to the destruction of the life of the individual. It is highly important, therefore, so far as the question of amputation is concerned, that a distinction should always be drawn between idiopathic and traumatic gangrene, inasmuch as the course to be pursued in the two cases is essentially different,—the first always requiring that the operation should be

delayed until the progress of the gangrene has become arrested, whereas the second demands the performance of amputation at as early a period as practicable, otherwise it will proceed until it destroys life.

B. *Fractures.* A simple fracture of one of the extremities, can never of itself justify a resort to amputation, but this accident may be complicated with such other injuries as to render it expedient or necessary to remove the limb. Compound and comminuted fractures, however, much more frequently exact that procedure, inasmuch as there is not only a fracture of the bone, but at the same time such extensive contusion and laceration of the soft parts,—such destruction of important blood-vessels and nerves, that the vital powers succumb under the shock to which they are exposed, extensive sphacelus ensues if the part be not removed by an operation, and death will be speedily induced. It is possible, nevertheless, to save many limbs which have suffered compound and comminuted fractures of apparently the worst kind, and the surgeon ought always to consider it his duty to allow the patient every justifiable chance for the preservation of his member, but should never suffer his anxiety for the attainment of this end, to carry him so far as to sacrifice the life of his patient. The surgeon's situation is one of great responsibility, and the most acute exercise of his powers of judgment will be necessary, to enable him to decide when to sacrifice the limb to preserve life, or when he should attempt to save both life and limb. It was formerly the rule to regard almost every case of compound fracture of a large bone, as one requiring immediate amputation. Pott protested strongly against the adoption of such a principle, and happily illustrated in his own case, the powers of the system when seconded by judicious treatment, to bring about a restoration even under very unpromising circumstances. At the present time, compound and comminuted fractures are managed upon the same principles that direct us in the treatment of those of a simple kind, and instead of considering them generally as calling for immediate amputation, it is seldom found necessary to resort to such an alternative, except in extreme cases. When the bone is extensively comminuted or broken into several pieces, if the soft parts be not at the same time extensively contused or torn, the member may be generally saved, especially if the principal vessels and nerves escape unhurt. Under these circumstances, the loose pieces of bone should be picked away, and the limb submitted to such treatment as is calculated to prevent or subdue inflammation, and to obviate the consequences to which it is apt to lead. This course will be especially advisable, when the accident has taken place near the central portion of one of the cylindrical bones; but, should it occur in the immediate vicinity of a large and important articulation, and be complicated with great injury of the soft parts, a successful issue can seldom be hoped for, as extensive gangrene will be almost certain to ensue, and life can only be saved by a timely recourse to amputation. The mere protrusion of the extremity of the bone in a compound fracture cannot require amputation, even though the soft parts be considerably injured; but should the violence by which the accident is produced, give rise to a destruction of the principal vessels and nerves, contuse or lacerate the muscles, the tendons, and other structures, so as to destroy their vitality, amputation will be indispensably necessary, and ought not to be delayed. It should be remarked, however, that the circumstances of the patient, and his situation at the time, will exercise an important influence on the decision of the surgeon. On the field of battle, on ship-board, and in large hospitals, it will often be necessary to sacrifice limbs which in private practice might be easily preserved.

C. *Dislocations.* The simple displacement of a bone, can never constitute a necessity for amputation. But unfortunately some accidents of this kind are attended with such an extensive injury of the soft parts, or even of the bones themselves, that the removal of the member may become necessary to save the life of the patient. This is not unfrequently the case in that form of the injury attended with a protrusion of the bone through the surrounding parts, constituting what is called a compound dislocation, which, when the accident occurs in one of the large articulations, sometimes gives rise to such extensive constitutional irritation, or alarming gangrene, as speedily to terminate the existence of the individual. Injuries of this kind are, indeed, of so formidable a character, that some of the army surgeons have laid it down as a rule, that amputation should be performed in all cases of compound dislocation of the ankle joints, and this practice was adopted to a certain extent by J. L. Petit, though his own experience furnished him with numerous cases in which such injuries did well without the member being removed. With regard

to the propriety or impropriety of amputating for compound dislocations, much must depend upon the kind of articulation involved, the extent of the injury, and the nature of the parts implicated by it. Such a procedure can seldom be proper when the joint is small and of a simple character. But when the injury is inflicted upon the large hinge joints, as the knee and the ankle, the consequences involved are of a much more serious character. Still it is not impossible, even under these unfavourable circumstances, to preserve the member. As a general rule, if the head of the bone has merely protruded through the soft parts, without being fractured or violently contused, without inflicting extensive injury upon the important vessels and nerves, or the other structures surrounding the joint, the limb may be saved by returning the bone to its situation, maintaining it in an easy position, and vigorously combating inflammation. The operation, therefore, ought not to be performed under such circumstances, until a proper attempt has been made to preserve the member. But should the part become involved in an extensive gangrene, it must be immediately resorted to, otherwise the disease will extend with such rapidity as to occasion death before any line of separation can be established. In more desperate cases, where the bones are fractured or violently contused, when the soft parts are extensively lacerated and bruised, the principal arteries and nerves torn up, and the tendons and their sheaths seriously injured, any attempt to save the limb will generally be at the hazard of the life of the individual, as even under the best directed course of treatment, gangrene or tetanus generally supervene, and run on rapidly to a fatal termination; or if these consequences should not ensue, violent constitutional disturbance is generally developed, or profuse suppurations take place in the joint, attended with caries and exfoliation, under which the patient will sooner or later succumb, if he be not relieved by the timely performance of the operation. It must nevertheless be confessed, that even some of the worst cases occasionally do well; yet by acting upon the principle of endeavouring to save the limb in all such instances, although we may be occasionally successful, it will be at the expense of many lives. Judging from our own experience, we should say, that in compound dislocations of the ankle joint attended with extensive injuries of the important soft parts surrounding the articulation, the case will very generally terminate fatally if amputation be not performed; and this will be especially apt to occur where the constitution of the individual is feeble, or has been broken down by intemperance. It is nevertheless the duty of the surgeon, in all cases where there is the slightest probability that the limb can be saved, to make an effort for its preservation. (See *Ankle, Dislocations of.*)

Compound dislocations of the knee are of rather rare occurrence; but when they do take place, they are very generally followed by formidable consequences. In some instances, indeed, the popliteal vessels and nerves are torn up, while most of the other structures are extensively contused and lacerated, so as to render it impossible for the nutritive acts of the member to be supported. The heads of the bones themselves may be fractured or violently injured, so as to lay the foundation for intense inflammation of the parts concerned, and other alarming results. All such complicated cases require immediate amputation, and any attempt to save the limb will almost invariably lead to the destruction of the patient by gangrene, tetanus, or extensive suppuration and irritative fever. But should the bone merely protrude, without inflicting much injury upon the vessels and nerves, or the other structures connected with the articulation, the limb may be very generally saved, and an attempt ought always to be made to preserve it previously to resorting to the operation. (See *Knee, Dislocations of.*)

Dislocations of the astragalus frequently involve serious consequences, even where the integuments are not broken. They are very apt to be succeeded by gangrene, which, extending rapidly, soon terminates fatally. The unsuccessful issue of such cases induced Boyer to recommend that amputation should always be performed where the bone is completely displaced, and the result of subsequent observations has in a great degree confirmed the correctness of this rule, though successful results have sometimes been obtained by pursuing an opposite course.

D. *Caries, Necrosis, and Exostosis.* When one of the cylindrical bones becomes profoundly involved in caries or necrosis, although nature properly aided by the resources of art is generally competent to bring about a restoration to health, amputation nevertheless presents itself in some cases as the only means by which the life of the patient can be pre-

served. Should the disease of the bone be of limited extent, and only involve the superficial portion of its shaft, or even if it implicate the entire thickness of the latter, and be unattended with any extensive fistulous openings or sinuses in the soft parts, or profuse and wasting suppurations, the recuperative powers of the system will generally prove adequate to detach the dead portion from the living, and all that will be necessary for the surgeon will be to withdraw the sequestrum, and to treat the case upon general principles. Even where no such separation is accomplished, whether the necrosis be situated upon the surface or within the cavity of the bone, the dead portion may be removed by the trephine, a Heys saw, or by the mallet and gouge, and the member may be preserved. Such cases, however, are always tedious, and generally inflict considerable disturbance upon the system. The process by which the dead bone is detached and thrown off is slowly accomplished, and as the system is suffering during the whole period by profuse suppurations and exhausting irritation, the individual, if the disease be extensive, will sometimes become exhausted before a cure can be consummated. This will be especially apt to occur if the reticulated structure of the articulating extremities of the bones, together with the joints, be involved, or even if nearly the whole extent of the shaft be implicated, provided there be at the same time numerous and extensive sinuses or fistulæ, profuse and unhealthy suppuration, a broken-down or feeble constitution, and a high degree of hectic fever. Such a concurrence of circumstances will generally require amputation, inasmuch as the powers of life will be found too feeble to bear up under so much suffering. It should, however, always be borne in mind, that the resources of the system are very great; that cures are frequently accomplished under circumstances apparently of the most unfavourable character; and consequently, we should reserve the operation as a last resort, and only perform it where we find that the system is rapidly giving way under the influence of the disease, and that a cure cannot be accomplished by any other course of procedure.

Amputation should not be performed on account of an exostosis, except when the magnitude of the tumour, or the peculiarity of its situation, completely disables the member, or interferes with the execution of some important function. Even then the operation cannot be often necessary; for, by removing the morbid growth itself from its connexions with the bone, all the difficulties may be removed, without depriving the individual of the use of his limb. A case may occur, however, in which extirpation of the tumour cannot be accomplished, and the amputation of the member may become necessary.

E. *White Swelling, and other diseases of the joints.* Diseases involving the articular cartilages, the reticulated extremities of the bones, and the other structures which enter into the formation of the joints, are generally attended with great disturbance of the constitution, and not unfrequently lead to very distressing consequences. The various conditions which have been vaguely described under the appellation of white swelling, though generally differing from each other at the commencement, for the most part lead ultimately to the same consequences. The morbid action may have its origin in these cases either in the synovial membrane, the articular cartilages, or the reticulated structure of the bones. In either event, all these structures may be destroyed; the synovial membranes and cartilages become extensively ulcerated; the bones themselves involved in a profound and disorganizing caries; the cavity of the joint be filled with a large quantity of offensive purulent matter, intermixed with the debris of the osseous and cartilaginous tissues; and besides, the surrounding soft parts may be perforated by numerous fistulæ, or traversed by sinuses, from which matter is constantly draining, or which merely give exit to a small quantity of unhealthy sanies. With these conditions there is also violent constitutional disturbance, consisting at first of an intense irritative fever, but gradually acquiring all the characters of hectic, with profuse night sweats, much pain and suffering, wasting diarrhœa, and prostration of strength, all which, if not arrested, terminate sooner or later in death. But however urgent the demand for amputation may be under some of these circumstances, the surgeon should not be hasty in sacrificing the member. The increased resources of modern surgery furnish means of conducting many such cases to a favourable issue without that operation, and many limbs are now saved by judicious treatment, which in former times would have been submitted to the knife. But with all our advantages and improvements, necessity still obliges us in many instances to resort, as a last remedy, to amputation. Should the disease proceed so far as to give rise to a large accumulation of matter in the joint,

and an extensive destruction of the cartilages and bones, and if the individual be at the same time worn down by hectic and diarrhœa, the operation cannot be longer delayed, but should be immediately performed. While, however, the general health remains but little impaired, and the structures surrounding the joint retain their integrity, or are not traversed by fistulous openings, and if the cartilages and bones be not at the same time extensively involved in ulceration and caries, it would be premature to remove the limb, inasmuch as by perseverance in a proper course of treatment the disease may be cured. It is moreover an important fact, that even after extreme emaciation and exhaustion have been induced by the constitutional suffering, the system rallies promptly after the operation, and the patient speedily regains his former state of health.

Amputation has also been proposed by some surgeons on account of the development of adventitious cartilages within the knee joint. This has even been advised by Kluge; but it is exceedingly questionable if such a case can ever require so formidable a procedure. Most surgeons prefer the removal of the cartilages themselves,—an operation which, though sometimes attended with fatal consequences, has nevertheless been often practised with success.

F. *Gun-shot and other contused and lacerated wounds of the extremities.* Few accidents to which human nature is liable, more frequently create a necessity for amputation than violent contused and lacerated wounds, whether occasioned by projectiles propelled by gun-powder, as amidst the horrors of war,—splinters of wood, as in naval engagements,—by an individual becoming entangled in machinery,—by the blow of obtuse bodies falling from a height,—or where the subject of the accident himself falls or is thrown so as to come in violent contact with any body capable of inflicting such an injury. In either case, the soft parts are generally violently contused or lacerated,—the muscles, vessels, and nerves, are reduced to a kind of pulp or jelly,—the bones are crushed or comminuted,—the vitality of the structures receives such a shock that they speedily become gangrenous,—and the march of destruction is so rapid, that unless it be arrested by speedy amputation, the individual soon falls a victim to its ravages. Such cases are frequently very embarrassing to the surgeon, for it is exceedingly difficult to discriminate between those in which the limb may be saved by judicious treatment, and such as require that it should be sacrificed for the more important purpose of preserving life. In confiding too much in the resources of the art and the sanative powers of nature, many invaluable lives have been sacrificed, which might have been saved by amputation: and on the other hand, it is equally certain, that limbs have been removed which might have been preserved. The results of experience, indeed, have been so various in relation to such accidents, that we scarcely find any two surgeons inculcating the same principles; some restricting amputation to a very limited number of the worst kind of cases, while others have advised it under many circumstances where the injury is comparatively trivial. Where there is so much discrepancy, it is difficult to prescribe any positive laws, and all that can be done is to lay down certain general rules, which of course must be liable to many exceptions, arising from the local circumstances of the individual, the strength of his constitution, and the facilities and advantages which may exist for conducting the treatment of the case. Thus, on the field of battle, from the number of cases which have to be attended to, the few conveniences which are at hand, and the distance to which the wounded have frequently to be transported, many limbs must of necessity be sacrificed, which under the favourable circumstances existing in private practice, might be saved. Also, in crowded and ill-ventilated hospitals, where all injuries evince a tendency to become gangrenous, or to assume an unhealthy character, amputation must be more frequently performed than in many other situations.

There are various circumstances attending contused, lacerated, and gun-shot wounds of the extremities, which will render amputation necessary.

When a cannon-ball, the velocity of which is somewhat expended, strikes one of the members in such a manner as to glance off from it, although the skin may not be broken, there will frequently be such a violent contusion of the soft parts beneath,—so much injury of the vessels, muscles, and nerves,—and in many cases also of the bones, that the parts are rendered incapable of executing their vital acts, and will speedily run into mortification, if the limb be not removed. Even if the vessels and nerves be not torn, they are often so much contused, that the functions of circulation and innervation

are suspended in the affected parts and in those situated lower down, and sloughing and gangrene must inevitably ensue.

In other cases, the soft parts, including the principal arteries and nerves, may be so extensively contused and lacerated by a cannon-shot, the fragment of a shell, splinters of wood, musket-shot, &c.—the bone may be so bared, contused, or shattered, and part of the circumference of the limb so profoundly injured, as to render immediate amputation necessary. Nor can there be the slightest question of the propriety of the operation under such circumstances; for if it be neglected, or too long delayed, extensive mortification or tetanus will sooner or later supervene and destroy the patient. In some instances, however, the limb may be saved, even though considerably lacerated, provided the principal vessels and nerves have escaped injury, and the bone has not been extensively comminuted. Amputation will also be generally necessary where a member has been violently crushed by the passage of a heavily laden wagon or car over it, so as to mash the bones, and inflict a violent contusion upon the soft parts; as also in those cases in which a limb has been carried away by a cannon-shot, the bursting of a bomb, or where it has been torn off by machinery; for in the former case, gangrene will inevitably ensue, and in the latter, the parts are left in such a ragged and lacerated condition, with the bone at the same time projecting, that they will not heal until after considerable sloughing has taken place; and even then, the protrusion of the bone is so considerable that it cannot be covered by the soft parts, and the stump presents an irregular, unseemly appearance. To obviate these latter difficulties, it is proper to substitute a clean incision for the irregular division of the parts accomplished by the accident. It may, moreover, be affirmed in general terms, that amputation will be requisite in all cases of gun-shot wounds in which the bones of either the arms or legs are extensively shattered; and it has been correctly remarked, by Græfe and Guthrie, that injuries of this kind affecting the lower extremities, much more frequently call for the operation than those of the arm. Velpeau says, that when both the tibia and fibula are extensively shattered, the case will generally require amputation; and Ravaton long since observed, that a similar accident taking place in the thigh, will be almost constantly fatal if the operation be not performed. According to Schmucker, not more than one can be saved out of seven without amputation, and nearly the same observation has been made by Lombard. Ribes places the importance of the removal of the member in such cases in a still stronger point of view. He states, that of ten cases submitted to the most careful treatment, not one terminated favourably; and that at the Hôtel des Invalides, containing about four thousand individuals, he had been unable to find a single one who had been cured of such an accident. Nearly the same results have been observed by most of the army surgeons of extensive experience, and especially by Percy, Larrey, Hennen, Gaulthier de Claubry, S. Cooper, Guthrie, Thomson, and others. The surgeons who treated the wounded of July, 1830, in France, were not much more successful. Lisfranc succeeded in one case at La Pitié: Dupuytren also saved one individual without amputation; and Arnel mentions three others which did well. Somme cured two out of eight, at Antwerp, and a few other instances of success were obtained at Paris and Brussels. Velpeau, however, was unfortunate in the only case which fell under his management, although the fracture appeared to be of not a very bad character. (*Médecine Opératoire*, I. 285. Paris, 1832.)

It is certainly the duty of the surgeon to use every exertion to preserve the member, in all cases where there is a probability of his being able to do so; but when an attempt to accomplish that object is fraught with such hazard to the life of the individual, it is certainly unjustifiable to jeopard his existence for the sake of the limb.

Wounds and injuries of the joints, also frequently require amputation. This is especially true of the larger hinge joints, as the knee, ankle, elbow, and wrist. A simple penetrating wound, inflicted by a sharp instrument, even though it enter the articulation and give exit to the synovial fluid, will not of itself demand such a procedure; yet, from the nature of the structures implicated, and the violent constitutional disturbance to which they are capable of giving origin when intensely inflamed, such consequences frequently supervene upon accidents of this kind, as to render it necessary to remove the limb. Should the articulation be penetrated by a musket-ball, a fragment of a shell, a splinter of wood, or any other obtuse body,—should the soft parts and the ends of the bones be violently contused or lacerated, or the latter fractured or comminuted, there ought to be no hesitation

with regard to the propriety of amputating. Gangrene or tetanus will almost invariably ensue, and if they should not, such violent inflammation and constitutional disturbance, together with profuse exhausting suppuration, tedious caries, and exfoliation, will take place, as to cause the patient to fall a victim to the protracted irritation. Sometimes, however, it will be better to resort to the resection or excision of the injured articulation, than to remove the entire limb, inasmuch as by adopting the former course, the utility of the member will be in part preserved, while the mutilation and deformity inflicted upon the patient will be less considerable. BILGUER condemned amputation in some of these cases, and several successful results have been obtained by different surgeons, without resorting to that operation. But when these are compared to the innumerable reverses which have followed the neglect of amputation, it must be apparent to every candid mind, that to sacrifice so many individuals for the attainment of an occasional fortunate issue, can be regarded in no other light than as a wanton tampering with human life.

G. *Extensive suppuration and ulceration affecting some part of the upper or lower extremities.* There are but few circumstances connected with a process of suppuration or ulceration of the extremities, which can render it necessary or expedient to resort to amputation. Where extensive deposits of matter form, the fluid should be evacuated; fistulæ and sinuses be freely laid open, and ulcers managed by appropriate constitutional and local treatment. If the bones or articulations be not involved in the disease, these means will generally be found efficacious, and amputation not be requisite. In some instances, nevertheless, extensive purulent deposits take place in some part of the member; the matter becomes diffused in the interstices of the muscles; the vessels, nerves, and bones are laid bare; hectic, diarrhœa and emaciation ensue, and if relief be not afforded, the individual will be exhausted by irritation. These are cases in which it may be proper to consider the propriety of removing the limb. Reasoning a priori, the operation would seem to promise important advantages, yet experience has by no means realized what reason had encouraged us to hope. The removal of the source of irritation has, it is true, in a few instances, been followed by a successful termination; yet in a large majority of instances in which amputation has been practised under such circumstances, the purulent deposits have shown themselves subsequently at some other point, and the patient has eventually fallen a victim to his disease. VELPEAU states, that in every instance in which he had seen the operation resorted to, the individual died, and extensive purulent deposits were found in the abdominal viscera; and our own experience has furnished us with nearly the same results. If the general health be but slightly impaired, the operation can never be justifiable, however extensive and profuse the suppurative process; and when the constitution is already exhausted, the nutritive and assimilative acts profoundly perverted, and the functions of circulation and innervation worn down by disease, should the individual possess sufficient stamina to endure the operation, the recuperative powers of his system are so enfeebled, that he will almost invariably succumb under the additional injury inflicted upon his organism.

Of suppuration connected with a diseased condition of the bones and joints, we have already spoken as a condition requiring amputation. A mere suppuration within the cavity of an articulation does not of itself require the removal of the member. But it sometimes happens, that the synovial membranes, cartilages, bones, and capsules become so extensively involved, that such a procedure is rendered indispensable for the preservation of life. The course of the surgeon under these circumstances, must be guided by the extent of the disease and the sufferings of the patient; and even when these are considerable, it will often be better to excise the diseased articulation than to remove the entire limb.

With regard to the propriety of amputation for extensive ulcers of the extremities, much must depend upon the extent of the disease and the effect it has on the constitution, or the inconvenience it occasions to the individual. It has been stated by LANGENBECK, (*Nosologie und Therapie der Chirurgeschen Krankheiten*, II. 678. Götting. 1823) that the limb should only be removed in those cases which are attended with such an extensive destruction of the soft parts that these cannot be regenerated. It should always be remembered, however, that where this condition has been allowed to exist for years, the system becomes, as it were, habituated to it:—the diseased part performs the office of a drain, or excretory organ, which it is often dangerous to remove, unless a seton or issue be inserted, as a temporary substitute. In all cases of this kind, the operation can only

be considered one of *complaisance*, and not of necessity, and should only be performed in those cases in which the member is so great a source of encumbrance to the individual as to disqualify him for the ordinary offices of life; and even under these circumstances, great circumspection ought to be observed, lest, by attempting to liberate our patient from a bodily embarrassment, we sacrifice his life.

H. *Large Aneurismal Tumours*, which were by the older surgeons enumerated amongst the causes requiring amputation, can never demand such a step, except where they are complicated with some other condition; as extensive caries of the bones, gangrene or sloughing; or such a profound destruction of the soft parts, as to render it impracticable to save the limb. In all other cases, the treatment should be conducted upon the principles furnished by the multiplied resources of modern surgery. Nor are we disposed to admit the propriety of removing the member on account of hemorrhage, either primary or secondary, inasmuch as it will always be practicable to cut down and secure the vessels at another point, or to command the bleeding by some one of the numerous means ordinarily employed for that purpose.

I. *Fungus Hæmatodes, Encephaloid, Cancerous and other degenerations.* These formidable heteroclyte degenerations to which the extremities in common with other parts of the body are liable, have too often baffled every variety of treatment, and even set the knife of the surgeon at defiance. They are for the most part insidious in their development, but so exceedingly rapid in their march, that in many cases, before we can be fairly apprized of the nature of the disease, the internal organs have already become so extensively contaminated as to render the success of any operation altogether abortive: the removal of the primary affection is soon succeeded by its re-development in some other situation, and the disease runs on with rapid strides to a fatal termination. It is still possible, however, for some of these degenerations, when they are of limited extent, and do not implicate the substance of the bones, to be removed without sacrificing the limb. Yet in by far the greater number of these, where a considerable extent of the limb is involved—where the bones themselves are also implicated, and especially when the disease presents the characters of fungus hæmatodes, or encephaloid or melanotic degeneration, experience has demonstrated that speedy amputation presents the only means of rescuing the individual from inevitable destruction. Even this resource sometimes disappoints all our hopes, the disease soon making its appearance at some other point, and advancing with such rapidity as to render it impossible to arrest its progress. The removal of the member, nevertheless, sometimes succeeds, even under unpromising circumstances, and should always be practised where there is the slightest prospect of success. We, in one case, amputated in the immediate vicinity of the trochanters, where nearly the whole of the thigh from the knee upwards was involved in extensive encephaloid degeneration; and, notwithstanding the inguinal and iliac glands were greatly enlarged, nearly the whole stump healed up by the first intention, and the individual has had no return of the disease. In adopting this course, it will always be advisable to perform the operation at a considerable distance from the seat of the disease. In a case of fungus hæmatodes of the tarsus, in which Grossheim removed the member below the knee, he found a kind of degeneration which was inclosed in a proper membrane, extending for some distance above the internal malleolus, along the course of the posterior tibial nerve, to which it was attached by loose cellular tissue, without, however, implicating its neurilema. (*Lehrbuch der Operativen Chirurgie Zweiter Theil.* p. 524. Berlin, 1831.) If the operation had been performed below the limit of this degeneration, the disease would doubtless have been re-developed, and the case have terminated fatally. It is, however, always difficult to determine the precise limit of the disease; for, although the external parts may appear healthy, it often happens that some of the deeper-seated structures are profoundly involved. We once examined an individual who died of a fungus hæmatodes developed upon the internal side of the tibia, and, notwithstanding the morbid affection did not seem to extend very high, the course of the principal vessels, throughout the whole extent of the thigh, and even in the abdomen, was surrounded by a diffluent pulpy material, resulting from the dissolution of the degenerated encephaloid mass.

Amputation will also be demanded when the bones are affected with the condition denominated *spina ventosa*, *osteosarcoma*, &c., as well as in that affection of the osseous tissue, which has been designated by modern pathologists under the appellation of *colloid* degeneration. Kluge and many other surgeons, have, moreover, recommended the operation to be performed for

the removal of limbs affected by elephantiasis, and it has been often practised with success under such circumstances.

K. *Tetanus* has been supposed by some surgeons, especially Larrey, to require amputation. Any individual, however, who will give himself the trouble to reflect upon the nature of this accident, will be at once convinced that the removal of the original injury cannot overcome the important changes to which it has already given rise in the cerebro-spinal centre. The condition is altogether traumatic at its commencement, but in a short time after the injury is inflicted, such vital modifications are developed by it, that the perversion of function which is thus originated, will continue to act, although its original source be removed. We accordingly find, that in nearly all the cases in which amputation has been performed for the purpose of arresting tetanus, the disease has progressed, without being influenced in the slightest degree by the operation. This happened in two cases, even to Larrey himself; and it has fallen to our lot to see every case terminate fatally, in which the operation was resorted to. So unfortunate, indeed, have been the general results of this practice, that it is condemned by a large majority of modern surgeons, and the very small number of successful cases which have occurred, cannot be considered as at all sufficient to justify its adoption as a general rule. Indeed, it may be affirmed, that universal experience is decidedly against the operation. The reports of Sir James M'Grigor, deduced from the extensive experience of the surgeons of the British army, are highly unfavourable to its adoption, and the same remark may be made in relation to the results obtained by the French. Even Larrey himself confined it to chronic cases, which are of rare occurrence; and Sir A. Cooper interdicts it in these cases, declaring that it is unjustifiable, inasmuch as the individual often recovers without this proceeding. It has, indeed, been very correctly observed by Rust, (*Handbuch der Chirurgie*, I. 512. Berlin, 1830.) that by resorting to amputation after the spasms have become developed, we merely amputate the wound, but not the tetanus.

L. *Amputation from complaisance.* Under this head may be enumerated those cases where amputation is not necessary for the preservation of the life of the individual, but in which it may be sometimes resorted to on account of some acquired vice of conformation of one of the extremities, which renders it an encumbrance to the individual, and disqualifies him for the common offices of life, and the enjoyment of its comforts. Numerous examples fall under the observation of the surgeon, which, from the impatience of the individuals to be disembarrassed of the deformity and inconvenience to which they are exposed, render it necessary that he should decide upon the propriety or impropriety of amputation. Of this kind, are permanent and rigid distortions of the members, partial or complete anchylosis of the joints, extensive, ancient and incurable ulcers, sinuses, fistulæ, artificial joints, &c. none of which endanger the life of the individual, while most of them are a source of so much inconvenience as to render the sufferer anxious to be relieved. With regard to incurable ulcers, we have already spoken; and we can now only subjoin, that in a large proportion of the other conditions enumerated, the propriety of amputation is exceedingly questionable. It is a curious fact, and one which has been fully established by experience, that operations performed under such circumstances, are generally followed by fatal consequences, notwithstanding the condition of the patient is such as to promise a successful issue. Too much circumspection cannot, therefore, be observed by surgeons in yielding to the earnest entreaties of individuals, some of whom evince so ardent a desire to be released from their troubles, that they are willing to incur every hazard, and will insist on having the member amputated, although fully apprized that the result may be fatal. Numerous cases have been reported which place this subject in the strongest point of view, and show how important it is that the practitioner should never so far lose sight of moral rectitude, as to undertake an operation which cannot be necessary, and which may jeopard the life of his patient.

In 1821, a stout, robust individual, in the enjoyment of full health, entered the Hôpital St. Louis, with the fixed determination to undergo the amputation of the thigh, on account of an anchylosis of the knee, which obliged him to walk with a crutch. Richerand used every endeavour to dissuade him from his purpose, by depicting to him in the most glaring colours, the hazardous consequences which it involved, but finally yielded to the inflexible entreaties of his patient. The operation was accordingly performed, and everything seemed at first to promise well; but he was shortly attacked with an ataxic fever, which terminated fatally on the fifth day.

A similar example is reported by Pelletan. In 1825, an old soldier, wearied with a chronic enlargement of the leg, accompanied with an ulcer of long standing, situated behind the malleolus, presented himself at the clinical wards of l'ecole de Médecine, with the determination to have the limb amputated. All the arguments and entreaties which could be urged by Roux, were in vain, and finally yielding to the importunities of the individual, the operation was performed without the occurrence of any untoward circumstance. A train of symptoms was nevertheless soon developed, which terminated fatally at the end of a week. Velpeau reports similar instances, and in one case in which he merely amputated the index finger at its articulation with the metacarpal bone, in consequence of a permanent flexure of that member upon the palm of the hand, although the individual finally recovered, he was affected during a whole fortnight with the most alarming symptoms. (*Médecine Opératoire.* I. 280.)

These cases point out very forcibly the impropriety of adopting a procedure fraught with danger, for the removal of a comparatively trivial inconvenience; and the surgeon should, therefore, always be convinced of the necessity of the operation, before he yields to the solicitations of those who request it to be performed.

§ 3. *The period most favourable for amputation.* There is no point connected with the subject of amputation, which it is more important to determine, than the period at which the operation can be most successfully performed, and few unfortunately have given origin to so much diversity of opinion. The importance of the question relates more especially to those cases in which the operation becomes necessary on account of external violence inflicted upon the member, and those in which it is demanded for the removal of a limb affected with gangrene, though it is not unimportant in cases of a chronic character. In the first set of cases, it is called primitive amputation where the operation is performed on the spot, or within a short period after the receipt of the injury; and consecutive, where it is not practised until after the expiration of several days, or subsequent to the subsidence of the disturbance which follows the accident. These are the points upon which the discussion has mainly turned,—one party advocating immediate amputation, while the other has as strenuously insisted upon the propriety of delaying it until the tumult of the system aroused by the injury has entirely subsided.

The practice of immediate amputation in gun-shot wounds requiring that operation, was long since strongly recommended by Wiseman, (*Chirurgical Works,*) who has been generally considered as the father of English Surgery; and was much insisted on by Le Dran, (*Traité des Plaies d'armes à feu*, Aph. 9.), who expressly declares, "that where the amputation of a limb is indispensably necessary in the case of a gun-shot wound, it ought to be done without delay," and "that if there is a sure means of preventing the inflammatory symptoms, or bad consequences resulting from injuries of the joints, it is that of quickly removing the limb." It should be stated, however, that in 1625, long before the publication of Wiseman's opinion on this subject, primary amputation had been recommended by Du Chesne. This last named surgeon was convinced of the danger of amputating after inflammation had developed itself, and very wisely recommended the removal of the limb before that event took place. Ranby also advised a similar practice, and states several instances which fell under his own observations, during the campaigns of Flanders, strongly corroborative of the correctness of his opinion. (*The method of treating gun-shot wounds,* 1781.) The question, however, was most strongly agitated by the French Academy of Surgery, which in 1756 made it the subject of its prize for that year. On that occasion two memoirs were produced, which out of many others were alone considered as possessing any important claims; one by Faure, a military surgeon; the other by Le Conte, who was engaged in private practice at Arcueil. The prize was awarded to the former, on the ground that his opinions were supported by experience; but both advocated the doctrine of delaying the operation whenever it was practicable to do so, even though it should from the first be manifest that amputation would be indispensably necessary. The recommendation of Faure purported to have been founded upon the results of ten cases of secondary amputation, reserved expressly for the occasion, after the battle of Fontenoi, all of which were successful. This success appears at first sight so satisfactory, and so much greater than that which is generally obtained, that if there could not be brought forward any circumstances to invalidate the conclusions involved, it would be impossible longer

to dispute the comparative merits of primary and secondary amputation. It should be stated, however, that both Faure and Le Conte, have each designated a considerable number of cases, in which immediate amputation is indispensably necessary, and in which the individuals could not possibly survive until the arrival of the favourable period for amputation which they have prescribed. It is expressly stated by Faure, that where a member has been carried away—an important articulation violently fractured—the bone of an extremity shattered, with an extensive destruction of the soft parts, or the bones been minutely comminuted and surrounded by a considerable contusion of the soft parts, with laceration of the tendons and aponeurosis—where the structures of the large joints are torn, and the bones are simultaneously fractured, or where the main artery is lacerated and the hemorrhage cannot be controlled by any other means, it would be dangerous to defer the operation. (*Prix de l'Académie Royale de Chirurgie.* III. 334. 8vo. Paris, 1819.) Under all these circumstances, he subjoins, that the prompt abstraction of the injured part is the only means possessed by the art, that can be opposed successfully to those consequences still more formidable, which will inevitably supervene if amputation be delayed.

It is clearly manifest, therefore, that although secondary amputation may have been performed successfully, in the whole ten cases, as stated by Faure, we have no assurance that an equal or greater number of individuals may not have been lost by the delay of the operation, who might have been saved by its prompt adoption on the field. No allowance having been made for these cases, the facts and arguments adduced are far from being conclusive; and it was, we think, with much reason that Boucher objected to the validity of the inferences drawn by the Academy of Surgery. There is no satisfactory evidence that these ten cases would not have done equally well if immediate amputation had been practised; and acting upon this supposition, it is manifest that by postponing the operation until the subsidence of the troublesome symptoms, a large proportion of patients who cannot survive until that period, and who might be saved by early amputation, must be inevitably lost.

Boucher, who has carefully examined all the grounds taken by Faure in his memoir, has demonstrated three periods, at which it will be proper to resort to the operation.

1. The period intervening between the receipt of the injury, and the development of the accidental symptoms, to which it gives rise. The tension, inflammatory swelling, throbbing, acute pain, fever, &c. which constitute the ordinary consequences of gun-shot wounds, do not make their appearance suddenly, but are sooner or later developed, according to the extent and complications of the wound, and the nature of the constitution of the patient.

2. Where the symptoms developed are more or less capable of disturbing the system.

3. The period at which the urgency of the symptoms has either abated or entirely subsided,—corresponding to that at which Faure recommended the operation to be performed. (Boucher, *Mémoires de l' Académie Royale de Chirurgie.* II. 326. 8vo. Paris, 1819.)

The operation may be performed successfully at either of these periods, yet if a candid appeal be made to the results of experience, especially to that of the Army and Navy Surgeons, whose opportunities of observation are the most extensive, it will be seen that primary amputation in gun-shot wounds has been attended with far more fortunate results than the practice recommended by Faure and Le Conte, and which was also subsequently advised by Hunter, Lombard, Levielle, and others. Indeed many surgeons engaged in private practice have been fully aware of this fact, and we accordingly find Pott, John Bell, and several others, recommending immediate amputation before the correctness of the practice was fully established by those who had a more ample field for observation. Even Schmucker, who succeeded Bilguer, as Surgeon-in-Chief of the Prussian Armies, and who was much opposed to amputation, recommends in express terms, that when the operation is necessary it should be performed before inflammation makes its appearance, (*Chirurgische, Wahrnemungen.* II. 500.); and Boy gives the same advice, (*Wedekinds Nachricht überd. Franz. Kriegs, spitalwesen.* I. 1797.) Larrey, whose authority is of the highest value upon all points relating to military surgery, is a warm advocate for immediate amputation, not only in the worst cases of gun-shot and other wounds, but in all acute diseases in which it is impossible to save the limb, (*Clinique Chirurgicale.* III. 514. Paris, 1829, also *Campaigns*, translated by Dr. Hall, Baltimore, 1814.) To

him, especially, is modern surgery indebted for having first established this practice as a principle, the correctness of which has been subsequently confirmed by GUTHRIE, HENNEN, HUTCHINSON, THOMSON, SAMUEL COOPER, GOURAUD, and which has been acknowledged and acted upon by RUST, KLUGE, DUPUYTREN, RICHERAND, ROUX, MARJOLIN, LISFRANC, GOSSHEIM, LANGENBECK, BLANDIN, VELPEAU, and indeed most modern surgeons. Whenever, therefore, it is possible to resort to the operation before the inflammatory symptoms make their appearance, if it is determined that the limb cannot be saved, there should be no delay in amputating after the patient has sufficiently recovered from the effect of the shock to render it safe to operate. The propriety and necessity of this course have been fully confirmed by experience.

DUBOR states, that during the American war in 1780, the French surgeons were unsuccessful in almost every case of amputation, because the operation was deferred; while those of the American army, who operated on the spot, saved nearly all their patients. FERCOC, who had the treatment of the wounded after the celebrated naval engagement of the first of June, 1794, represents that out of a great number upon whom immediate amputation was performed, only two died, and their death was occasioned by tetanus. The surgeon of the *Téméraire*, which was taken by the English, influenced by the advice of their surgeons, delayed the operation, and had the mortification to see all his wounded perish before the period for consecutive amputation arrived. (LARREY, *Op. Cit.* p. 515.) The same striking contrast was observed by MASCLET, after the engagement at Aboukir. Eleven cases in which immediate amputation was practised all did well, while three others, in which the operation was delayed eight days, terminated fatally. After the affair of Newbourg, Baron PERCY performed eighty-two immediate amputations, out of which number only six terminated fatally; and LARREY saved twelve out of fourteen. The same preponderance of success attending primary over secondary amputations, was observed in the British army during the Peninsular war, as is satisfactorily demonstrated by the documents obtained by Sir JAMES M'GRIGOR. It appears from those documents, that out of 551 amputations performed in hospital, within the space of six months, when of course the operation was consecutive, 265 were unsuccessful; whereas, out of 291 cases, in which the operation was practised on the field of battle, only twenty-four terminated fatally,—making the ratio of unsuccessful cases in secondary to those which occurred in primary amputation, 15 to 2. (GUTHRIE *on Gun-shot Wounds*, &c. p. 228. London, 1827.) A still more extraordinary success attended primary amputation in India. According to the official return of Dr. BURKE, out of eighty cases in which that practice was pursued at Buhrpore, every one terminated favourably, (Sir G. BALLINGALL'S *Military Surgery*, p. 410. Edinburgh, 1833.); and it is stated by DEL SIGNORE, who accompanied the French expedition into Egypt, that after the battle of Navarino, he lost only one patient out of thirty in which the operation was immediately performed, while he saved only twenty-five out of thirty-eight cases after secondary amputation. Similar results were obtained after the French revolution of July, 1830. VELPEAU states that nearly a hundred amputations were performed at the several hospitals of Paris, of which number by far the greater proportion were successful, when the operation was practised early. Nearly all the cases of primary amputations terminated favourably, while most of those which were secondary ended fatally. (*Médecine Opératoire.* I. 293.)

Taking all these facts into consideration, the question so long agitated relative to the comparative advantages of primary and secondary amputation, may be considered as fairly settled in favour of the former, and the practice recommended by FAURE and LE CONTE, and inculcated by the old French Academy of Surgery, is proved not only to be erroneous, but fraught with dangerous consequences. There is, however, one fact stated by SANSON and BALLINGALL, which must not be passed over in silence. These surgeons affirm, that the striking advantages of primary over secondary amputation observed in military practice do not take place to the same extent in civil hospitals. Attempts have been made to explain this circumstance upon the operation of causes partly moral and partly physical, and there can be no doubt that such influences do frequently impress very important modifications upon the success of an operation. The moral depression experienced by an individual, who has perhaps a large family dependent on his exertions for support, and who finds himself suddenly, and frequently by imprudence, deprived of the ability of furnishing them with subsistence, would naturally tend to place the system in a condition highly unfavourable to amputation. To this must

also be added the fact, that he has been accustomed to active and wholesome exercise in a pure and salubrious atmosphere, and that he is suddenly transferred to the crowded and contaminated wards of a civil hospital, which are apt to excite fever even in an individual in perfect health, and it will be readily conceived why an operation should under such circumstances be less fortunate than with the soldier, who is seldom exposed to the operation of such causes.

The principal arguments which have been urged by those who condemn immediate amputation, have reference to the condition of the patient, and the chance that limbs may be sacrificed, which by delaying the operation might be preserved.

It is well known to all surgeons who are conversant with the phenomena of gun-shot and other violent wounds, that these accidents frequently inflict an alarming shock upon the individual, and sometimes occasion a temporary prostration or a suspension of the vital powers. As John Bell has forcibly expressed it, "the individual is overtaken with an awful trembling and disorder of the nervous system: the bravest cannot resist it; and the most acute physiologist cannot tell whether it is a disorder of the body or a tumult of the mind." "There is an instant affection of all the body, a trembling and unaccountable sinking within, yellowness of the face, paleness of the extremities, a failing of the pulse, and a livid wound from which no blood is discharged." (*Discourses on the Nature and Cure of Wounds.* I. 132.) This state of the system has been very justly urged by the advocates of consecutive amputation against the propriety of performing the operation immediately. But what sensible surgeon would ever think of removing a limb in such a state of the system? Such a practice has never been recommended, and we feel assured would never be adopted by any man who is at all conversant with the principles of his profession. There is always a period intervening between the receipt of the injury and the development of the inflammatory symptoms,—a period which was very accurately designated by Boucher, at which the operation should be performed. Until the patient is aroused from the stupor occasioned by the shock sustained by his nervous system, the operation will be hazardous, and it should always be a rule to delay until the powers of animation are resuscitated,—until the nervous system resumes its functions, and the heart and arteries emerge from their state of oppression, whether that event take place in one or twenty-four hours. Thus long it will be proper to wait, and no longer. If the operation be delayed until the inflammatory symptoms have become fairly developed, we shall frequently have suffered a golden opportunity to escape, in which all of the patient's salvation may be involved, and deprive him too frequently of the only chance between life and death. Whatever is to be done must be done quickly, "*and where there is plainly a necessity for losing a limb, the sooner it is done the better*," provided the individual has sufficiently recovered from the depression of the vital powers occasioned by the injury. (Le Dran, *Op. Cit.*)

When, however, circumstances render it impracticable to resort to primary amputation, and the inflammatory symptoms have already made their appearance, all our hopes of success must rest upon our ability to conduct the patient safely through the stage of excitement, fever, and suppuration, and bring him to the period recommended by Faure as the most favourable for the operation. Amputation must not be thought of while the whole system is in this tumultuous condition, except it should be demanded by the rapid progress of gangrene, in which case the removal of the limb, as we have already attempted to show, ought not to be delayed. Did not experience itself teach the hazardous consequences of amputating while the stage of inflammation is at its height, both reason and analogy would deter us from the adoption of such a course. What, in effect, is the general conduct of the surgeon under such circumstances in relation to other operations? He does not practise lithotomy without previously bringing the system to a proper condition; neither does he operate for cataract while the eye is affected with acute inflammation. The removal of a member. therefore, which is always productive of a much more violent commotion of the system, should be regulated by the same principles; and if the operation has been neglected until the vital powers are thrown into a tumult, it should be still further delayed, and the surgeon must direct all his energies to control the inflammatory action, and induce a calm favourable to the success of the amputation. The only circumstance which can justify or require a departure from this rule is a marked tendency of the wounded limb to run into gangrene. Here it would be dangerous to wait for the development of a well-defined limit between the dead and the living parts: death will

ensue before such an occurrence can take place, and the concurrent experience of most modern surgeons of extensive observation, has confirmed the correctness of the practice so ably inculcated by LARREY, of immediate amputation in cases of traumatic gangrene. LANGENBECK has very correctly observed, that under such circumstances, there is "*periculum in mora*," and he states that he has sometimes amputated with the most fortunate results, even where the limb was enormously swollen, but had not yet become gangrenous. (*Nosologie und Therapie der Chirurgischen Krankheiten.* IV. 266. Götting. 1830.) This practice should not be adopted, however, except where mortification is inevitable, and then it must be regarded as a matter of necessity, and not of choice.

Should this necessity for amputation, during the persistence of the inflammation, not exist, the surgeon must content himself with such treatment as will be calculated to bring about a calm in the conflicting acts of the living organism; and when that is induced, which will generally be within a period varying from 15 to 25 or 30 days, the member may be removed with much greater probability of success than at any other moment, except that which has been designated as the most advantageous for primary amputation. Here, however, much must depend upon the constitution of the individual, the condition of the limb, and the state of the internal organs. The patient is too frequently exhausted by profuse suppuration and hectic, or becomes affected with a formidable lesion of some of the important viscera, so that, should the operation be performed with the greatest care and judgment, the issue will often be unfortunate, on account of the enfeebled vital energies being incompetent to sustain the additional aggression thus made upon them. But if the removal of the member has been necessary from the commencement, and there is now no possibility of preserving it, amputation must be regarded as the "*unicum remedium*," and should be practised, although the chances of success be unpromising. There are, nevertheless, some circumstances which will render the operation altogether hopeless. These consist, for the most part, in the existence of a dangerous or incurable disease in some part or organ essential to life; as phthisis pulmonalis, hæmoptysis, general or local dropsy, lumbar abscess attended with caries of the spine, a disease of the heart or large vessels, an abscess of the liver, an ulcerated condition of the intestines with chronic diarrhœa, an indication of the development of a cancerous or some other similar condition higher up than the point at which it will be possible to amputate, and such a profound implication of the system in a general scrofulous, syphilitic, scorbutic, or rheumatic diathesis, as to give rise to a re-development of the disease at some other point, after the member has been removed. Extreme debility may, moreover, constitute a counter-indication to the operation. Yet experience has demonstrated, that in many cases where the debility is considerable, the removal of the violent and exhausting irritation kept up by the diseased limb, is soon followed by a rapid improvement of the corporeal energies of the system, and a speedy restoration to health. Under many of these circumstances, much may be accomplished by judicious preparatory treatment, and accordingly, such a course should always be adopted as will have a tendency to put the constitution of the patient in such a condition as will best qualify it to endure the operation.

§ 4. *The most eligible point for the performance of amputation.* Upon this point there is far less difference of opinion at the present day, than in former times. Many of the ancients recommended the incision to be always made through the mortified parts, and although CELSUS prescribed a different procedure, their advice was generally followed, until its impropriety was exposed by WISEMAN. Since his time, it has been the established practice to cut through the living parts, either at, or a little above, the line of demarcation by which they are separated from the dead. This rule is now never departed from where amputation proper is performed, and a different course is only adopted, when the object is merely to disembarrass the limb of the gangrenous structures.

As regards the precise part of the member upon which the operation should be performed, it must be determined by the necessities of the case, founded upon the situation and extent of the disease, the condition of the structures, and the member, or part of the member, affected. The operation may be performed either through the substance of the bone, or through the articulation; the one or the other of which should be preferred, according to the limb that may be affected, and the character of the joint. In fixing upon the point at which it should be executed, we have what is called the point of *election*, and that of *necessity*; but in many cases, the first is entirely wanting, in conse-

quence of the disease being so situated as to leave us no alternative but to amputate at a particular place.

It may be laid down as a general rule, that the member should be removed at that point which will insure the effectual extirpation of the disease, and the preservation of the greatest possible quantity of the limb. Thus, in cases of gangrene, where the sloughing process has been arrested, the incision should be made immediately above the line of separation between the dead and living parts; but when it is still progressive, it must be made sufficiently remote from the seat of the disease to insure its passage through parts which are healthy. If this precaution be neglected, it will often be found, that although the operation is performed on parts which externally have a healthy appearance, the incision will be carried through structures which are in a sloughy condition, and the disease will be renewed and extended with increased rapidity. Where the member is affected with an encephaloid or carcinomatous degeneration, or any specific form of disease which would be liable to recur, great care must be taken to operate at a point sufficiently removed from the seat of the disease, to insure the extirpation of the whole of the part involved in the morbid affection. The same rule must be observed in other cases, when the affection of the bone extends higher up than that of the soft parts; for although the latter may exhibit a healthy aspect, the former may be so extensively involved as to perpetuate the disease after the member has been amputated, unless the operation be performed upon a healthy portion of the bone. A simple induration of the structures, however, can never require the sacrifice of a considerable portion of the limb. Such a condition is generally excited by the long-continued influence of local inflammation existing in a fistulous passage, or some other morbid state of either the bone or the soft parts, and will speedily disappear after the removal of the source of irritation. It has been recommended not to amputate in the vicinity of a large joint, and as a general rule, this precept should be observed. There are, nevertheless, cases in which it ought to be departed from. Should a disease or injury of the leg or arm, be situated so high up as to leave no alternative but to amputate in the vicinity of the knee or elbow, or above those articulations, the former procedure must be adopted, inasmuch as those joints are so useful to the individual, that they ought not to be sacrificed, except from absolute necessity. Larrey, and several other surgeons, have amputated with complete success, even through the reticulated substance of the head of the tibia, and thus preserved the use of the articulation, by which a great advantage was secured in the adaptation of a wooden leg.

It is desirable to perform the operation upon that portion of the limb which is capable of affording the best flap or covering for the stump. Hence, in amputating the upper and lower extremities, the operation can be better performed through the calf of the leg, or the thick part of the arm, than in the vicinity of the ankle or wrist, because of the thinness of the integuments in these latter situations, and the greater difficulty of obtaining union by the first intention. To secure these advantages, however, too much must not be sacrificed. Amputations generally do well in the tendinous parts of the leg and arm, and as it is important to save as much of the member as possible, when the disease or injury is situated low enough down to admit of the operation being performed at these points, the objects to which we have adverted can never constitute a sufficient reason for unnecessarily sacrificing a member which may be useful to the individual.

There is one other rule of practice to which we are anxious to advert. It has been the practice with many surgeons, when the humerus or femur has been shattered in the immediate vicinity of their articulations, either by musket or cannon-shot, and when the soft parts have been extensively contused or lacerated; or when a necrosis of these bones occupies the same situation, to resort to amputation at the shoulder or hip joint. This conduct is exceedingly improper. The operation may, in a majority of such cases, be successfully performed through the continuity of the bone, and the individual will thus be saved the pain and hazard of an amputation through the articulation. The advice of Baron Larrey, to amputate at the shoulder joint in preference, whenever there is not room to operate so low as the attachment of the deltoid muscle, should never be followed. It is founded upon the presumption that the extremity of the bone will be drawn towards the side, and occasion a protrusion of its extremity, and likewise upon the apprehension of the irritation of the brachial plexus of nerves, likely to result from the application of a ligature to the artery so high up. Expe-

rience has shown that the first difficulty can be easily prevented by the use of a small pad or compress, inserted in the axilla; and the second does not apply more to this operation than to that at the shoulder joint. Whenever, therefore, there is space enough to saw the humerus immediately below its tubercles, or the femur through the point at which its shaft and neck unite, that procedure ought to be adopted in preference to the operation through the hip or shoulder joints. Or should these bones be extensively shattered or necrosed, with a simultaneous implication of the soft parts, rendering the sacrifice of the members indispensable; if the heads of the bones have escaped, it will sometimes be better to divide the soft parts in the most advantageous manner, and pick away the fragments of bone, or the sequestrum, than to operate at the articulations. (C. Bell, *Two Lectures*, &c.)

§ 5. *Comparative advantages of Amputation through the continuity and in the contiguity of the bones.* It has been already stated, that by amputation through the continuity of a bone, is meant that operation by which the bone is sawed through, while that which is practised in their contiguity, consists in the removal of a member through one of its articulations.

Amputation at the joints was condemned by Celsus, but was particularly recommended by Galen, as the most expeditious and safest method of performing the operation. The opinion of the latter was combated by Heliodorus, who insisted upon the superior advantages of amputating through the continuity of the bones. His advice was generally adopted by surgeons, until Brasdor and Larrey, in modern times, again called the attention of the profession to the advantages of operating at the joints, and the latter proved, by his success in the campaigns of the French army, the reality of these advantages. Since that time, it has been satisfactorily demonstrated by repeated experience, that many of the fears which were formerly entertained relative to cutting into an articulation, were for the most part groundless; and if it is not safe to amputate through the larger hinge joints, this operation can be more advantageously performed through some of smaller magnitude, than at any other point. At the present time, therefore, the merits of both methods are acknowledged, and the one or the other is adopted, according to their individual adaptation to the part which is to be removed. The only difficulty consists in determining the cases in which one method should be resorted to in preference to the other, and in deciding which will be the easiest and safest to the individual. The characters of the joints themselves, together with a knowledge of their comparative tendencies to suffer from injuries inflicted upon them, should be our principal guide upon this point. It will thus be generally observed, that the hazard attending amputation at the articulations will be always in a ratio with their extent, and the complicated character of their arrangement. The hip and shoulder joints, those of the phalanges of the fingers and toes, of the metatarsus and metacarpus, wrist, &c., present a less extent of surface, and are more simple in their arrangement, than those of the knee and elbow. Hence it has been found by repeated observation, that amputation may be safely performed at those points, whereas, at the elbow and knee, especially at the latter, though sometimes successful, it is by far a more hazardous operation, and occasionally gives rise to formidable consequences. Nor is it difficult to explain this difference of result. The knee joint presents a large extent of surface, covered by cartilage and synovial membrane, the latter of which presents numerous reflexions, which increase its extent. The expanded extremities of the bones, moreover, which contribute to the formation of the joint, are besides composed of a delicate reticulated structure, which, as well as the other parts of the apparatus, is very liable to take on extensive inflammation. This process, when once developed, not only occasions severe constitutional disturbance, but frequently terminates also in troublesome suppuration and caries, by which the life of the individual may be jeoparded. The elbow, to a certain extent, presents an analagous arrangement, and is also liable to similar accidents, though in an inferior degree. Amputations, therefore, performed at these articulations, have been generally found less successful than those that are executed at other points; and such alarming symptoms have sometimes been developed, that many surgeons have been deterred from resorting to the operation, especially at the knee. There is, besides, another fact to be taken into account in determining upon the comparative advantages of the two methods of operating. The cartilages, in consequence of their peculiarity of organization, and the feebleness of their vital powers, take on less readily the adhesive form of inflammation than the bones themselves; and when a large extent of such a surface is exposed, it sometimes happens, that,

although the flaps unite as under ordinary circumstances, a cavity remains in relation with the central part of the stump, in which tedious suppurations take place, and retard the cure. To this accident the knee joint in particular is much exposed, and it may also occur at the elbow. Those, however, which present less extent of surface, are not so liable to any serious consequences; and it has been found, accordingly, that amputations through them, prove as successful as those which are practised upon the continuity of the bones.

Influenced by these and other principles, surgeons of the present day seldom amputate at any but the smaller and more simple articulations. The operation at the shoulder and hip, are only practised from absolute necessity, and these articulations being simple and of limited extent, the operation, especially at the shoulder joint, generally proves successful. At other points it is different: we have our choice to amputate at the joint or through the substance of the bone, and the one or the other place should be adopted, according as it may be more advantageous or safer to the patient. The phalanges of the fingers and toes, the bones of the metacarpus, metatarsus, carpus, and tarsus, and the wrist, may be generally amputated with greater facility through their articulations than by any other procedure, and with these joints this method should be generally preferred:—we say generally, because there are a few exceptions, which we shall point out under the head of the individual amputations. The operation is never performed at the ankle joint, because of the impracticability of saving a sufficiency of soft parts to form a flap. As no possible advantage can accrue from merely saving the condyles of the femur and humerus, and as amputation at the knee and elbow always exposes the individual to unnecessary hazard, the operation should never be performed at those points.

Whether amputation be performed at the articulations, or through the continuity of the bones, there are two leading methods in general use, to which all the modifications may be referred. The first, which is of the greatest antiquity, is by what is called the *circular incision;* the second, by a *single* or *double flap.*

§ 6. *Preparation of the patient previous to Amputation.* The operation of amputation is always attended with much pain, and various preparatory means have been recommended with a view of diminishing the sufferings of the patient. For this purpose, some of the ancient surgeons required the individual to inhale by the nose the vapours of certain narcotics, but in modern times, they have been generally administered either by the mouth, or by injection. Laudanum or opium have been most employed, but when their administration has been considered improper, hyoscyamus and other narcotics have been substituted. Græfe insists much upon the propriety of abating the nervous sensibility by means of appropriate remedies, before the operation; and with this object, when opium is not contra-indicated by a general plethoric condition of the system, idiosyncrasy, or any other cause, he recommends that about sixteen drops of Sydenham's liquid laudanum should be administered to the patient. To those who have been accustomed to the use of the article, the dose may be increased; but he remarks that it should never be carried to the extent of producing an unpleasant determination to the head. After the nervous system has been brought under the soothing influence of the narcotic, the individual, he assures us, will bear the operation with much less suffering, and will generally escape the horripilation which is so apt to supervene when this precaution is neglected. Instead of the chills which so frequently follow the operation, he will generally fall into an easy, tranquil slumber, from which he will awake much refreshed. When the anodyne cannot be administered by the mouth, without creating unpleasant consequences, he prescribes it by injection. For this purpose, he employs a drachm of laudanum, or a scruple of the root of belladonna, in three ounces of chamomile tea, to be thrown into the bowels four hours before the operation. In some cases, the belladonna used in this way produces a more happy effect than any of the preparations of opium. When neither can be employed, he always uses a simple injection, for the purpose of removing irritation from the bowels, and obviating the necessity for the patient to rise to stool until sufficient time has elapsed after the operation to allow its effects to subside. (*Normen für die ablösung grösserer Gliedmassen*, p. 43. Berlin, 1812.)

These views are certainly judicious; but perhaps it will be advantageous to give a greater quantity of anodyne by the mouth than the dose recommended by Græfe. We have generally administered from forty to sixty drops of laudanum, and have witnessed no bad consequences from its employment. It is possible, however, for an over-dose of the narcotic to excite a

kind of erethism of the cerebro-spinal centre, of a mischievous tendency; and it has besides been urged against its employment under these circumstances, by Rust and Kluge, who are opposed to its administration, that it exposes the patient to secondary hemorrhage.

It has been proposed by some, with the view of diminishing nervous sensibility, to screw the tourniquet very tight around the member, so as to compress the nerves; and for this purpose, Graefe even recommends a second tourniquet without a pad to be applied above that which is used to command the artery. We can perceive no advantage likely to result from the adoption of this course; but on the contrary, have sometimes seen almost as much pain induced by the violent constriction of the instrument, as from the amputation itself.

Among other acts of preparation, the mind must not be neglected. Much of the success of an important operation depends upon the fortitude of the individual to endure it with confidence and firmness. His resolution should be fortified by soothing encouragement, and every precaution be taken to prevent the energies of his nervous system from sustaining a violent shock from the overpowering influence of fear or apprehension. Doubtless all the vaunted effects of animal magnetism, of which we have heard so much within a few years, are to be attributed to the confidence inspired by it in the mind of the patient. In the present state of our knowledge at least, the full latitude of our credulity will not admit of our allowing it any other influence.

The most favourable period for the performance of this, as well as other operations, is in the morning. But there is no period of the twenty-four hours, and no season of the year, at which it may not be safely resorted to. The surgeon, in the selection of the time, must be governed by the circumstances of the case: and when these are urgent, he should act promptly, and without delay. If, however, the condition of the patient be such as not to render it important that the operation should be immediately performed, it will always be better to defer it, when the system is labouring under any inordinate nervous or vascular excitement, and if a female, especially during the period of the menstrual flux.

§ 7. *Apparatus and Instruments necessary in Amputation.* The apparatus and instruments necessary in the amputation of the members are variable, according to the kind of operation adopted, and the point at which it is performed. It will be proper, however, to enumerate all that will be requisite in the execution of the operation upon any part of the body.

There should be two good tourniquets, the straps and buckles of which have been previously tested, to determine their strength. Or, in cases of emergency, where this instrument is not at hand, a strong bandage, or a silk handkerchief, may be tied round the member, and rendered sufficiently tight by inserting beneath it the end of a stick, the hilt of a sword, or any convenient thing which may be at hand, with two or three turns of which the band may be twisted until it is rendered tight enough to command the circulation. For the same purpose, there should be provided a key, or boot-hook, with the end wrapped with lint or old linen, for the purpose of compressing the artery. Knives of different configurations and dimensions are employed, according to the kind of operation that is to be performed. They should always be of a length proportionate to the volume of the member. They were formerly made large, and of a falciform shape, that they might divide the greatest possible quantity of the soft parts by a single stroke. Louis first pointed out the imperfections of the curved instruments, and since his time they have been mostly abandoned. At the present time they are made entirely, or almost, straight upon the edge, and generally terminated by a point moderately sharp, or by one somewhat obtuse, and rounded or convex upon the edge, so that it may be employed in dissecting back the integuments. Those employed by most of the English surgeons have the blade broad and moderately thick, and the back gradually rounded off towards the point; while the French, and especially Lisfranc, have them made light, narrow, and sharp at the point. Those which are employed in the flap operation should be long enough to pass with facility through the most fleshy part of the member, and to allow room for the free play of the instrument,—should be narrow, and sharp on both edges, and terminated by a point ground dagger-fashion. Those for the hip joint should be about 12 inches long, and three-fourths of an inch broad near the handle. For the shoulder, the instrument need not be more than 8 inches in length. A catlin of smaller dimensions will be more convenient for the amputation of the arm, fore-arm, elbow, wrist, carpus, tarsus, &c., the size being always regulated by the dimensions of the part.

For the amputation between the bones of the tarsus, and in the carpo-metacarpal articulations, LISFRANC employs a very narrow catlin, because such an instrument can be more readily accommodated to the different manœuvres of the operation. For the amputation by the circular incision, the late Professor SMITH, of Yale College, employed a knife somewhat shorter than that in common use, but almost uniformly convex on the edge from heel to point, concave on the back, and terminated by an obtuse bevel at the extremity. GRÆFE'S knife is narrow at the heft, and broad at the other end. The edge from the handle to within a small distance of the other extremity is very slightly concave, but from thence out presents a strong convexity. The back is thick, rounded off, and perfectly straight, and the end of the instrument is truncated at a right angle with the back; this truncated extremity as it approaches the edge gradually terminating in its sharp convex portion. The object proposed by GRÆFE, in giving his knife this peculiar configuration, is, that in the act of making the oblique circular incision, the surgeon may rest the thumb and index finger of his left hand upon the back near its extremity, and thus have a better command of it.

There should also be one or more large convex scalpels, sharp-pointed bistouries, a retractory of soft leather or strong cloth, with two or three tails, according to circumstances; a good amputating saw with an extra blade, a metacarpal saw, bone forceps, one or more tenaculums, a pair of artery forceps with a slide or spring, and several crooked needles armed with ligatures. In dressing the stump it will be necessary to have a sufficient supply of silk or animal ligatures, of different sizes, and properly waxed; adhesive plaster spread and cut into strips; lint made into pledgets and spread with cerate; compresses; a roller bandage of coarse muslin three inches wide, and three or four yards in length; sponges, and warm and cold water; wine and water; bottles filled with hot water, or a chafing-dish with burning charcoal to warm the adhesive plasters; towels, &c. &c.

We employ a saw about three inches longer than that in common use, the handle of which is so attached as to form an obtuse angle with the blade. In consequence of this arrangement, much more force is thrown upon the teeth of the instrument at each propulsive effort, than when the handle is placed on the same line with the blade, and it cuts through the bone in nearly one half the time. The teeth should always be widely set, so as to form a furrow of sufficient dimensions to prevent the pinching of the instrument, which is always embarrassing, and sometimes causes the bone to be splintered before it is divided. GUTHRIE has recommended one range of the teeth of the saw to be directed obliquely forward, and the other backwards, so that the instrument may act as well during its retreat as its propulsion—There can be no advantage in this method of construction. In former times, most surgeons employed a kind of *bow saw*, constructed upon the same principles as the instrument still used for the amputation of the metacarpal and other small bones, and the same kind of saw is still preferred by some very able operators of the continent; but it is less steady, and far inferior to the common amputating saw.

The best retractors are made of kid skin, or chamois leather, but when this is not at hand, coarse muslin will answer very well. For the thigh, a piece 8 inches wide, and 14 inches long, should be divided lengthwise, from one end to the middle, and the end of the slit should be rounded out so as to adapt it to the contour of the bone. Holes are sometimes cut in the ends, or rings are attached, to receive the fingers of the assistant, but these can be very well dispensed with. For the leg or fore-arm, the retractor must be divided into three tails, one of which must be passed through the interosseous space. Neither here nor on the arm will it be necessary to have it so large as for the thigh, but merely wide enough to cover the face of the divided soft parts, and protect them from the saw.

Artery forceps are generally constructed with a slide, by which they can be fixed upon the extremity of the vessel; but the best are the spring forceps recommended by Professor N. R. SMITH. The instrument has a spring projecting from the inside of one of the blades, and passing through a hole in the other. On this spring there is a catch, which, when the blades are firmly compressed, takes hold of the blade, which it pierces, and keeps the instrument closed.—(N. R. SMITH, *Surgical Anatomy of the Arteries*, 4to. p. 17. Balt. 1832.)

All these implements should be arranged upon a table or a tray, in the order in which they will be required, and placed in a situation where they can be conveniently handed to the surgeon. They should be covered with a towel or cloth until the operation is commenced.

The patient is generally placed on a table covered with a mattress or several folded blankets, and with his head and shoulders elevated. When, however, the ope-

ration is to be performed at the shoulder joint, upon any part of the arm, the hand or foot, the sitting posture will be either necessary, or may be adopted from choice.

In the larger amputations, several assistants will be requisite, and none should be selected for so important an office but such as have sufficient firmness and address to entitle them to full confidence. Each one has his particular duties to perform, and they should all be so disposed as not to embarrass each other, or be in the way of the operator. One manages the circulation, either by the tourniquet or other means; a second grasps the member above the point at which it is to be taken off, ready to draw up the integuments, turn back the flaps, or apply the retractor; a third supports the member below, and holds it steady; a fourth hands the instruments as they are required, while others support the patient, and bestow upon him whatever attentions may be called for in the course of the operation.

It must not be inferred from what has been said, that all these implements and attentions will be requisite in performing the operation of amputation. We have detailed what ought to be at hand under favourable circumstances. But in cases of emergency, on the field of battle, in a naval engagement at sea, &c. many of these preparations must be dispensed with, and the apparatus simplified. This a skilful surgeon will always know how to do. Successful amputations have often been performed with a few simple implements. With a silk handkerchief twisted round the limb to command the hemorrhage, a scalpel, pocket-knife, or razor, to divide the soft parts; a common saw to cut through the bone, and a few ligatures, any of the members may be amputated, if not with as much dexterity and ease to the patient, with nearly as good a prospect of success, as with the most complex apparatus.

§ 8. *Means of commanding the hemorrhage during the operation.* The ancient surgeons, awed by the dread of hemorrhage, and ignorant of the proper means of commanding it, generally contented themselves with either amputating through the dead parts, or dividing the structures with a red-hot knife, and afterwards applying the actual cautery. But although this practice was generally adopted, there are reasons for supposing that the ligature may have been employed in amputation by some of the ancient surgeons, as it was certainly recommended in other operations by Celsus, Archigenes, and others. Circular compression was also employed by some of them, and it was upon this principle that the garter or field tourniquet, afterwards invented by Morel, was founded. This, as we have already explained, consists merely of a band tied round the member, and afterwards rendered sufficiently tight to compress the artery by inserting the end of a small stick beneath the band, and twisting it. To render the compression more effectual, a large compress was generally fixed over the course of the artery, and to prevent the skin from being folded and pinched, a roller bandage, or folded compress, was fixed round the member, with a piece of concave horn or wood beneath the portion of the garter or band which was to be twisted.—This arrangement will be found very convenient in cases of emergency, when the common screw tourniquet invented by J. L. Petit, is not at hand. The last named instrument, however, deserves the preference when it can be obtained, inasmuch as when once properly adjusted, it does not require so much attention from the assistant, and can always be rendered tighter or slacker merely by turning the screw. In adjusting it, the pad or cushion should be placed immediately over the artery, and the instrument itself so arranged in relation to the strap as to be fixed and screwed directly upon the pad. It is particularly important to have the buckle of the strap sufficiently removed from the frame of the instrument to prevent it from being arrested by it in turning the screw, otherwise serious embarrassment might occur in the course of the operation. Some surgeons make a few turns of a roller round the limb before the torniquet is applied, to prevent the skin from being pinched by the strap, and this will be found a useful precaution.

Although the tourniquet of Petit, improved and variously modified, is generally employed by modern surgeons, and is, under all circumstances where it is applicable, the safest means of commanding the hemorrhage during the operation, it cannot be applied in amputation at the hip and shoulder joints, or in the immediate vicinity of those articulations, and is liable to serious objections even under the circumstances to which it is applicable. The act of tightening the strap is always attended with great pain, by folding and pinching the skin, and violently constricting the deeper-seated parts. The application of the constriction to the whole circumference of the limb prevents the return of the venous blood from the member, and consequently as soon as the first incision is made, a profuse gush of that fluid takes place, which, in debilitated subjects, it is often

important to preserve. This can be generally prevented by applying pressure immediately upon the course of the artery, while the circumference of the limb is left free. And finally, it so constricts the muscles, that they cannot retract when divided, and the consequence is, that so soon as the instrument is removed, they do so in an unequal degree, and render the face of the stump irregular and uneven.—These considerations have induced many distinguished surgeons to abandon the tourniquet, and rely upon the simple compression of the artery either with the thumb or fingers of an assistant, or the extremity of a common key or boot-hook, wrapped with old linen or soft cloth. This plan is now very generally adopted by the French and German surgeons, and we always prefer it when we have an assistant in whom we can repose full confidence. The tourniquet, it must be confessed, is safer, and for that reason should be adopted where a proper assistant is not at hand.

But in amputating at the shoulder or hip, there is not room for the application of this instrument, and we are consequently compelled to rely upon compression. The instrument invented by Dahl for the compression of the axillary artery has been found inconvenient, and has in modern times given place to the compression of the subclavian where it crosses the first rib, behind the scalenus anticus muscle, or below the clavicle. The object is easier accomplished at the first point, because there the vessel is superficially situated, and the rib furnishes a solid point of support. To facilitate this end, the shoulder should be depressed, and the head of the patient inclined towards the opposite side. If it be on the left side, the assistant, standing in front, fixes the palm or face of the extremity of the thumb immediately above and behind the clavicle, and on the outer side of the posterior border of the sterno-mastoideus muscle, and directs the pressure obliquely downwards, backwards, and slightly inwards towards the upper surface of the first rib. When the artery of the right side is to be compressed, he may either stand before or behind the patient, (Langenbeck.) The artery may also be compressed below the clavicle, by having the shoulder elevated; but it cannot be so safely accomplished here as above. The best method of doing it is, to feel for the coracoid process, and apply the pressure immediately upon its inner side, between the pectoralis major and the deltoid muscles (Langenbeck). The brachial artery can be easily compressed where it courses along the inner margin of the caraco-brachialis and biceps muscles, at any point between the head of the humerus and the vicinity of the joint, the bone throughout all this distance furnishing a solid point of resistance.—The crural artery is superficially situated where it escapes from the abdomen, behind Poupart's ligament, and in front of the horizontal ramus of the pubis. It is at this point situated about midway between the spine of the ileum and the symphisis pubis, and may be easily compressed against the horizontal branch of the latter bone.

§ 9. *Amputation by the circular incision.* This is by far the most ancient method of performing the operation of amputation. It was recommended by Celsus and all the writers of antiquity, and is even at the present time more frequently employed than any other. It has, however, been submitted to a diversity of modifications, some of which it will be proper to mention. Celsus, and most of the ancients, divided the integuments and muscles by a single incision carried down to the bone,—a practice afterwards adopted by Gersdorf, Theodoric, Wiseman, and in more modern times, by Mursinna, Rust, Dupuytren, Kluge, and others. During the accomplishment of this act, an assistant is required to grasp the circumference of the member with both hands, and draw the soft parts forcibly upwards, while they are divided, so as to secure a sufficient covering for the stump. A much more usual method, however, is by what is called the double circular incision, first proposed by Maggi, and brought into notice by Petit and Cheselden. They divided the integuments by the first incision, while an assistant retracted them as much as possible, and then by a second incision, commencing on a level with the edge of the retracted integuments, they divided the muscles down to the bone. By this procedure, they were enabled to preserve sufficient integuments to invest the face of the stump, which in the method just described was also covered by the muscles. The operation may be very well performed in this manner where the diameter of the limb is not considerable, or the consolidation of the cellular tissue has not firmly united the skin with the subjacent muscles. But where the member is very large, or the skin is immovable, it will be difficult to preserve sufficient integuments.

To obviate these difficulties, it is customary, after making the first incision in the manner prescribed, to dissect up the integuments from the muscles, and turn them back like the cuff of a coat, and

then to divide the muscles on a level with the reversed integuments. There is, however, considerable difference of opinion relative to the quantity of integuments that should be saved, and the depth of the first incision. There is also some diversity of sentiment relative to the advantage of making the first cut by a full circular incision carried entirely round the member by a single sweep of the knife, or by two half circular incisions, one on the inner, the other on the outer side of the member, terminating in each other. The first is decidedly preferable, as it can be more expeditiously executed than the second. It is recommended by Mursinna, Kluge, Græfe, Zang, Dupuytren, and most of the French surgeons. The operation by two half circular incisions, however, is preferred by Langenbeck, Rust, and many of the surgeons of Great Britain and America. Rust makes the first half circular incision upon the under-part of the member, and then bringing the knife in front, carries the second from the internal extremity of the first, across the anterior part of the limb, to the point at which it terminated. Langenbeck, on the contrary, makes the anterior incision first.

As regards the quantity of skin to be saved, it must be determined by the diameter of the limb. J. L. Petit made the incision through the skin only an inch below the point at which the bone was to be sawed; but this method would not, where the member is large, secure sufficient integuments to cover the face of the stump. A much better precept is that recommended by Schreger, Hey, Brünninghausen, Lassus, and others; to make the extent of the detached or retracted integuments equal to one half the diameter of the member, according to Rust, one third, or one sixth its circumference. Thus, should the thickness of the limb be four inches, two inches of skin should be saved. In all cases, nevertheless, care must be taken not to dissect the integuments from the fascia or muscles farther than necessary, since if this precaution be neglected, the stump will be more apt to slough. Hey, Roux, and Syme, have strongly insisted upon the observance of this precept. The first merely dissected the integuments to the extent of half an inch on the back part of the limb, in amputating the thigh, and three quarters of an inch in front. The second contents himself with dividing a few of the filamentous bands of the cellular tissue, and when this will not allow a sufficient retraction of the integuments, divides a few of the superficial muscles in the manner practised by Louis.

By many surgeons the depth of the first incision is not deemed a matter of much importance. Some, however, have prescribed particular rules in relation to it.—Græfe, Hennen, Guthrie, and Hutchinson, recommend that the incision should be carried through the fascia so as to divide the superficial fibres of the muscles, with the view of facilitating the retraction of the integuments, and thus doing away with the necessity for much dissection. Hey, Brünninghausen, Langenbeck, Roux, and others, merely divide the integuments and leave the fascia entire. The reason alleged for this practice by Langenbeck is, that the aponeurosis serves to bind the muscles together, so as to prevent them from retracting irregularly where they are divided. We do not consider it a matter of much consequence whether the fascia be divided or not, provided the incision is fairly carried through the skin all round the member, and to insure this latter result, it will certainly be less painful, as correctly remarked by Græfe, to divide the fascia and superficial fibres of the muscles, than to be obliged to make several cuts to complete the division of the skin.

An assistant should grasp the member firmly with both hands a little above the point at which it is to be amputated, and draw them forcibly upwards. The surgeon may be placed on the outer or inner side, according to circumstances. With a large amputating knife grasped in his right hand, the edge of the instrument towards him, he carries it beneath the member, and bringing it over its anterior external part, if he is standing on the inner side, and vice versa, he inserts the edge near its heel, and cutting from thence towards the point, carries it round with a steady sweep, so as to terminate the incision at the point at which it was commenced. During the execution of the first part of this act, the hand is placed in a strong state of pronation, and the operator, with his right foot in advance, throws himself forward by flexing the knee: but towards its termination, he gradually approximates more to the erect posture, and brings his hand to a state of supination.—The incision should always be made perpendicular to the skin, and never obliquely, as recommended by Mynors. It has been correctly remarked by Græfe, that when the integuments are thus bevelled off, they cannot be so neatly approximated, and therefore do not heal so readily as under other circumstances. After

the incision has been thus carried round the member, the assistant should still retract the integuments, while the surgeon, either with the point of his knife, or with a common scalpel, cuts through the distended bands of filamentous cellular tissue, and secures that degree of retraction which may be necessary for the preservation of a proper covering. It is neither necessary nor proper to thrust the knife deep between the muscles and the tegumentary coverings, as is too frequently practised, inasmuch as the simple traction of the parts, while the filamentary bands are cut asunder, will secure the desired object, without the infliction of so much injury. Nor do we think it advisable to revert the skin, as is done by many surgeons, inasmuch as the muscles may be divided high enough without thus contusing and injuring the soft parts.

The division of the muscles, or the second incision, is variously executed by different surgeons. Most of these variations may, nevertheless, be reduced to three heads: 1, the division of the whole of the muscles by a perpendicular incision made on a line with the edge of the retracted integuments, and carried down to the bone; 2, the section of the superficial stratum of muscles first, and after they have been retracted, the division of the deep-seated above the line of the first incision; and 3, the section of the whole muscles by a single sweep of the knife, its edge, while it is conducted round the limb, being directed obliquely upwards, so as to make the face of the stump resemble a hollow cone.

The first of these methods was originally recommended by Celsus, and is perhaps more generally practised than any other. He however directed, that after the muscles were divided, they should be detached, a small distance, from the bone, so as to admit of its being sawed higher up than the line of the incision, (lib. VII. cap. 33.). This method of operating was adopted by B. Bell, but most modern surgeons have not deemed it necessary to dissect the muscles from the bone.

Louis and Le Dran recommended and practised the second method. But instead of limiting the first incision to the integuments, they achieved the division of the latter with the superficial stratum of muscles, by a single sweep of the knife, and after they were forcibly retracted, the deep-seated muscles were incised down to the bone, by a second cut. The object proposed by Louis in the adoption of this procedure, was, the prevention of the sugar-loaf or conical stump, which he conceived to be produced by the muscles retracting to a greater extent than the skin, and thus leaving an inadequate quantity of soft parts to furnish a full and rotund bolster of flesh around the bone. With the same view, Desault divided and dissected up the integuments in the usual manner, and then incised the muscles by two acts, as recommended by Louis. Both these plans of operating have been adopted by some modern surgeons, and that of Desault, with the modification of making the incisions through the muscles with the edge of the knife directed obliquely upwards, is more generally practised than any other modification of amputation by the circular incision.

Valentin, acting upon the supposition that important advantages would be secured by having all the muscles in a full state of relaxation when divided, proposed that the position of the member should be changed during the section of each set of muscles. When he wished to divide the muscles situated upon the inner part of the thigh, he had the limb carried inwards, and vice versa, during the division of the external. He also flexed the leg during the incision of the flexors, and extended it while the knife was carried through the extensors. A similar rule of practice was recommended by Portal; but Mursinna has advised a course directly the reverse. He recommends, during the division of the extensor muscles of the thigh, to have the leg forcibly flexed, and extended, while the flexors are divided. No advantage, however, can result from thus complicating an operation which is exceedingly simple; and decidedly the best general rule, whatever method of amputation be adopted, is that recommended by Rust,—to place the limb in a slightly flexed position, so as to have all the muscles as nearly as possible in the same state of extension.

The third method of dividing the muscles, consists in carrying the edge of the knife obliquely upwards, while it is made to sweep round the limb. This procedure was originally recommended by Alanson, whose plan of executing it was, however, so difficult, that few have ever attempted it, and many have even declared it to be impracticable. The integuments being firmly grasped and drawn upwards by an assistant, he divided and dissected them from the fascia in the usual manner, and then standing on the outer side of the member, he applied the edge of his knife under the edge of the supported integuments, upon the inner edge of the vastus internus muscle, and cut

obliquely through that and the adjacent muscles, upwards as to the limb, and down to the bone, so as to lay it bare, about three or four finger-breadths higher than is usually done by the common perpendicular circular incision. He now drew the knife towards himself; then keeping its point upon the bone, and the edge in the same oblique line already pointed out for the former incision, he divided the rest of the muscles in that direction all round the limb; the point of the knife being in contact with, and revolving round the bone, through the whole of the division. (COOPER's *Surg. Dict.* Art. *Amput.*)

LODER advocated the operation of ALANSON, with some modifications; and with still more important changes, its principles have been adopted by a majority of modern surgeons. It forms the basis of the operation of GRAEFE and DUPUYTREN, and, indeed, of nearly all those which are practised at the present day,—the object of all of them being to divide the soft parts so as to obtain a conical excavation, whether this be accomplished by the oblique incision of ALANSON, GRAEFE, DUPUYTREN, &c., the separate division of the superficial and deep muscles, as practised by LOUIS and LE DRAN, or the triple circular incision, while the parts are forcibly retracted, as recommended by DESAULT and HEY. With the view of increasing the depth of this excavation, we have already stated that CELSUS detached the deep-seated muscles from the bone, to a small extent. The same plan was adopted by B. BELL. GOOCH extended this dissection to the extent of an inch above the line of the incision of the muscles, and GUTHRIE as far as three or four inches above that point. The same practice has been commended by HELLO, DAVIDGE, and others, and VELPEAU states that by adopting it, the muscles can be more neatly adjusted over the end of the bone. We are not sensible of any advantages it is capable of affording, and, as we have already stated, there is no necessity for its adoption.

After all, these diversified modifications are of much less importance than might be inferred from the numerous disquisitions to which they have given origin. The operation may be very well performed by either of the plans which have been mentioned, but the following will perhaps be found the most convenient and expeditious method of securing all the objects proposed.

The patient being conveniently placed and everything properly disposed, the operator, by a single circular sweep carried steadily round the limb, divides the integuments fairly down to the muscles. The assistant still drawing these upwards, he next, with a few strokes with the point of the knife, or a common scalpel, divides the connecting bands of cellular tissue, until a sufficiency of skin is saved to cover the face of the stump. The extent of this dissection should of course be regulated by the diameter of the limb. In the thigh three or four inches will be required, but in the leg, arm, &c., a smaller quantity will suffice. The integuments, as we have already suggested, need not be reversed, as no advantage can accrue from that procedure. Inserting his knife a second time, on a line with the margin of the retracted parts, and with the edge directed obliquely upwards, the assistant still grasping the member with both hands, and retracting the structures, he makes a second circular cut through the muscles down to the bone, or at least so deep as to allow the more superficial to be drawn upwards. A third cut is next made in the same manner, inserting the edge of the knife, held, as before described, upon the base of the small cone formed by those muscles which are deepest seated, which is to be carried fairly down to the bone all round its circumference. By adopting this plan, the divided integuments and muscles will form a regular hollow cone, the centre or apex of which will correspond to the bone at the point at which it is to be divided by the saw. Where the member contains two bones, as in the leg and arm, besides the precautions already designated, the point of the knife should be made to glide in the interspace of the bones, while it is describing the circular evolution, as advised by LISFRANC; or if the operator is not expert, the structures which are situated between the bones may be divided with a common catlin, after the completion of the circular incision.

Sawing the bone is a part of the operation of amputation to which some of the ancient surgeons attached much importance; and even some of the moderns, influenced by the apprehension of tetanus, exfoliation, &c., from the injury of the periosteum, have advised great precaution in the division of that membrane, and its detachment from the bone, so as to have it entirely out of the reach of the teeth of the saw. To obviate these difficulties, WISEMAN, and many of his successors, carefully scraped the bone, so as to denude it of its periosteum. This practice, however, was justly condemned by ALANSON, J. L. PETIT, and others, and has in modern times been considered by a majority of the

best surgeons as highly improper. Guthrie states that he has often sawed through the bone, without previously touching the periosteum, and the stumps have been as soon healed, and with as little inconvenience as any others. (*Loc. Cit.* p. 278.) It should nevertheless be stated, that Græfe, Walther, and Brunninghausen, recommend the periosteum to be detached. The first divides that membrane at the point at which the bone is to be sawed, and rakes it downwards so as to be out of the way of the instrument. The two last, however, strip it upwards, to the extent of half an inch or more, so that with the muscular fibres which are attached to it, a partial covering for the edges of the bone after it is sawed may be preserved, which will serve to protect the surrounding parts, —a precaution they think of great importance when the bone presents a sharp angle, as is the case with the tibia. These precautions, however, are altogether useless. It was long since stated by J. L. Petit and Richter, that when the bone is thus extensively denuded, the saw is apt to be applied upon the middle point between the retracted edges of the periosteum, and consequently, that the part of the denuded bone remaining above the point of division, will be left to exfoliate. All that is necessary is to divide the membrane at the point at which the saw is to be applied, so that it may not become entangled in the teeth of the instrument.

Various means of supporting and protecting the soft parts during the act of sawing the bone have been devised, but no one is so good as the common leather or linen retractor already described. It should be somewhat wider than the diameter of the limb, and where there is but a single bone, slit in the middle one half its length: where there are two bones, the slit end must have three slips, one of which must be passed through the interosseous space. Graefe has advised the application of the undivided extremity of the retractor over the anterior part of the divided soft parts, and the two divisions to be crossed behind, and so adjusted as to protect the posterior soft parts of the member. Velpeau, however, thinks that it will be more advantageous to apply the undivided portion of the bandage posteriorly. We have never observed that it was a matter of any consequence in what manner the retractor was applied, provided the termination of the slit was made to embrace the bone accurately, and the two extremities were equally drawn. If the bandage should be allowed to fold upon the bone, or the parts be unequally retracted, it is apt to catch the teeth of the saw, and embarrass the operator.

The soft parts and the periosteum being divided, and the retractor applied, the operator fixes the thumb-nail of his left hand upon the bone at the point at which it is to be divided, to guide the saw, the heel of which he fixes upon the bone, and then making a slight pressure on the instrument, he draws it slowly and steadily towards him from heel to point, so as to form a superficial groove, the depth of which is increased by two or three light and steady alternate sweeps backwards and forwards. Having thus established a channel of sufficient depth to prevent the saw from slipping, he may conduct his strokes with greater rapidity and force, always making them long and free, and taking care, when the bone is nearly divided, to saw slower, so that it may not be splintered. The assistant, who supports the limb, should also be particular, during this step of the operation, not to allow any flexure which can pinch the saw, or fracture the bone. When there are two bones to be sawed, as in the leg and arm, the saw should be first made to play upon one of them until it forms for itself a groove, after which, by depressing or elevating the handle, it should be brought to bear upon both. The smaller of the two, however, must be cut through first. Should any spiculæ remain after the section of the bone, they must be removed by the bone-nippers or a scalpel. Some surgeons, indeed, have advised that the sharp edge of the bone should always be rounded off, to prevent it from injuring the soft parts when they are brought down over it.

§ 10. *Amputation with a single or double flap.* In the method of amputating by the circular incision, the covering for the face of the stump is either derived from the integuments, or from them and the superficial muscles. These coverings are taken equally from the whole contour of the member. In the flap operation, on the contrary, one or more flaps are formed, composed of the muscles and integuments, which, when laid down and adjusted, serve to cover the stump.

It has been generally supposed that this method of amputating was first proposed by an English surgeon named Lowdham, who described it in a letter written to Young, which was published in 1679, in the *Currus triumphalis è terebintho* of the latter individual. According to Sprengel, however, the flap operation was described by Celsus, Maggi, Leonidus, He-

LIODORUS, PARÉ, HILDANUS, and many others, who wrote long before the time of LOWDHAM and YOUNG. But notwithstanding that it was recommended by these authors, it did not attract much attention until revived and modified by VERDUIN of Amsterdam, and SABOURIN of Geneva, the former of whom insisted upon its advantages over the circular method when employed for the amputation of the leg. Though strongly opposed by many contemporary surgeons, it soon gained many advocates, and was afterwards espoused by MORAND, LA FAYE, GARENGEOT, LE DRAN, VERMALE, RAVATON, QUESNAY, O'HALLORAN, and others. RAVATON and VERMALE applied it to the amputation of the thigh, which they practised by making two flaps. In more modern times, the flap operation, variously modified, has been espoused by DESAULT, LARREY, WHITE, HEY, LOFFLER, LANGENBECK, KLEIN, BECK, TEXTOR, KERN, KOCH, RUST, GROSSHEIM, GUTHRIE, DUPUYTREN, LISFRANC, ROUX, SYME, VELPEAU, BLANDIN, &c.

The operation may be performed with either a single or with two or more flaps.

The first method was adopted by LOWDHAM, VERDUIN, and SABOURIN, in the amputation of the leg, and has been applied by various modern surgeons to the amputation of the shoulder, arm and fore-arm, elbow, wrist, carpal and metacarpal bones, the fingers and toes, the tarsus and metatarsus, and the knees. The cases to which it is applicable, or in which it has been recommended, will be designated in connexion with the particular operations.

The method with two flaps is more extensively applicable, and is more generally preferred. It has been differently executed, according to the object proposed, or the predilection of the surgeon. All flap operations, however, are performed either by cutting from without inwards, or by plunging the knife through the thick part of the member, and bringing it out so as to form a flap of the proper dimensions. The first of these methods, though somewhat more tedious than the second, is preferred by many operators, because of the greater facility afforded by it in regulating the form and dimensions of the flaps. The other procedure, however, is infinitely more prompt, and consequently less painful to the patient.

The operation of cutting from without inwards may be performed so as either to make the flaps of the integuments alone, or of them and the muscles together. KIRKLAND practised the former of these methods. He made an oblique incision through the integuments, first on the posterior, and then on the anterior face of the member, so as to form two semi-elliptical flaps. These incisions were directed with a regular curve, with its convexity inclined downwards, and described the outline of the flaps. They were commenced upon the centre of the inner or outer part of the member, and terminated at the opposite point, after having been carried, the first obliquely behind, the second in front. The tegumentary flaps thus formed were then dissected up, and turned back to the extent of half the diameter of the member, and the whole integuments being retracted, the muscles were divided by a circular incision down to the bone. By adopting this plan, an angular portion of integuments is removed from the internal and external portions of the flaps, so that when the latter are brought down upon the anterior and posterior portions of the stump, their edges are neatly approximated in a transverse direction, and the folding or puckering of the integuments which takes place at the angles of the wound in the circular operation is prevented.

The late Professor DAVIDGE, of the University of Maryland, improved the operation of KIRKLAND by incorporating with it the principles of the method of B. BELL. Instead of forming the two semi-elliptical flaps upon the posterior and anterior part of the member, as recommended by KIRKLAND, he made one external and the other internal, so that when approximated, the seam formed by their union extended from before backwards. He formed the two flaps by first making two lateral cuts with the large knife, mutually approaching above and below, to each other, to within two inches; and then, with an ordinary scalpel, bringing them into union in the centre of the thigh, before and behind, gradually ascending to about an inch and a half above the level of the first two lateral cuts. A better method is that practised by Dr. THOMAS WRIGHT, who forms the flaps by a dexterous sweep of the scalpel, first on the one side, and then on the other. (DAVIDGE'S *Physical Essays.* II. 95. Baltimore, 1814.)

The operation is more frequently practised without dissecting the integuments from the muscles, they being merely divided by the first incision and retracted; which done, a second incision is made upon a line with their margin, through the muscles, and down to the bone. This procedure should always be preferred when the parts are incised from without inwards, inasmuch as a better tegumentary covering

will be thus preserved, than when the skin, cellular tissue, and muscles, are all divided by a single sweep of the knife. It has been objected to it, that the operation is by the two incisions unnecessarily protracted, and the patient is consequently submitted to more pain than where only a single incision is made. These objections, however, are without much weight when the advantages secured are considered, and if we allow them to be valid, the best means of obviating them will be to transfix the member by the side of the bone, and divide the structures from the centre towards the circumference,—a plan, which, though condemned by many surgeons, has been adopted by a great number of others, and which we have always found more prompt and convenient than that just described. The method of forming the flaps by extending an incision obliquely from the surface to the bone, is preferred by Pott, Loffler, Langenbeck, Dorsey, Guthrie, Beclard, Dupuytren, N. R. Smith, and others. Chelius forms the first flap in this manner, and then transfixing the member on the other side of the bone, by introducing the knife at the angle of the first incision, he forms the second flap by cutting from within outwards. Ravaton, Le Dran, and B. Bell, divide the integuments and muscles by a circular incision, and then make a longitudinal cut upon the external and internal part of the member, the inferior extremities of which fall upon the circular incision. A similar method is recommended by Schreiner. Nearly all others, who prefer the flap amputation, execute the operation by thrusting a long narrow catlin through the member, first on one, and then on the other side of the bone, and cutting from thence towards the circumference. After the flaps are formed and held back, the muscles which adhere to the bone are divided by a circular incision.

As a general rule, the length of each flap, where two are formed, should be a little more than one half the diameter of the member, and it is advised by most surgeons to make both as near as possible of the same shape and dimensions. Guthrie, however, in amputating the thigh, makes the inner larger than the outer flap; but we are not sensible of any advantage that can be secured by such a procedure. Most generally one flap is formed upon the inner and the other upon the outer part of the member, but this step of the operation must often be determined by the condition of the soft parts, the member, or part of the member upon which the amputation has to be practised, and other circumstances which will be pointed out under the individual operations. Le Dran, Siebold, Zang, and others, have recommended that the flap containing the large vessels should be formed last; while Desault, and Rust, in the thigh especially, have advised the inner flap to be formed first, so that the soft parts situated on the outer side of the thigh may be drawn sufficiently outwards to admit of the second being made as large as the first.

The different modifications necessary to be observed in forming the flaps, and the principal methods of executing the flap operations, so as to adapt them to particular cases, will be described under the individual amputations, and need not be detailed here.

The question of the comparative advantages of amputation by the circular incision and the flaps, has given rise to much discussion, and can only be decided by examining their relation to particular cases. The flap operation, though strenuously advocated by many able surgeons since the time of Lowdham, has not been much employed until within the last thirty years. At the present time it is preferred by most of the surgeons of the continent of Europe; but although the authority of Liston, and Syme, has contributed to bring it into favor in Great Britain, the circular incision is still most frequently employed there, and in America. We are inclined, both from reason and personal experience, to prefer the flap operation in a large majority of cases, and we are pleased to observe, that in proportion as ancient prejudices are overcome, the members of the profession are every day becoming more sensible of its advantages.

It has been urged against amputation with the flaps, that it exposes a greater extent of surface than the circular incision; that the muscles are divided unequally; that the operation is more painful than by the circular incision; that greater difficulty is experienced in securing the bleeding vessels, in consequence of their being divided obliquely; and, finally, that the flaps are apt to slough, because of the extent of muscular substance involved.

These objections have induced many to give the preference to the circular incision, taking it for granted that they were well founded. Reiterated experience has demonstrated that most of them are altogether imaginary. As regards the first objection, it must be apparent to every one who is conversant with the subject, that, as in the operation by the circular incision sufficient

soft parts must be turned up to cover the face of the stump, and no more is done in the flap operation, there can be no great difference in the extent of surface exposed. Nor can we see that the muscles are more unequally divided: in the one case they are cut obliquely, and in the other in a direction nearly perpendicular to their axis, and as the divided surfaces from each side have to be brought in contact, the obliquity of the incision in the flap operation will be decidedly more advantageous in favouring an accurate apposition of the parts. If pain be insisted on as an objection, it will apply in a greater degree to the circular incision. The pain of all operations is in an inverse ratio with their quickness. That the circular operation is tedious, every one will allow who reflects upon the multiplicity of its steps. First, there is the cautious circular incision of the skin; the change of knife; the dissection of the skin; its turning back; the change of knife; the adjustment of the assistant's fingers, that they may not be cut off by the relentless sweep which divides the muscles; the change of knife; the separation of the muscles from the bone; the division of the periosteum; the application of the retractors, and, lastly, the sawing of the bone. (Syme, *Edinb. Med. & Surg. Journ.* XXI. p. 29. 1824). If these facts be considered, it must be admitted that the flap operation, as it can be more promptly executed, is by far the least painful of the two. We have not experienced any difficulty in securing the vessels in consequence of the obliquity of their division, nor do we believe that others have been less fortunate. The sloughing we maintain will be more apt to follow the operation by the circular incision, than where flaps are formed; because in the former case, all the delicate vascular connexions which exist between the integuments and muscles being cut up, it necessarily follows that their vitalism must be more impaired, than when they are left entire, and consequently they will be more liable to slough.

But while we insist on the advantages of the flap amputation, we would not be considered as recommending its indiscriminate adoption. There are cases in which the circular operation should be preferred, and as both methods will succeed very well, it should be left to the operator to select that which is best adapted to each individual case.

§ 11. *Amputation by the oblique or oval method.* The method of amputating by what Scoutetten has denominated the oval incision, was, according to Velpeau, proposed by Chasley, in 1803, or 1804. Langenbeck, who has been its most zealous advocate, recommended it in 1809, and since then it has been adopted in particular cases by Beclard, Guthrie, Richerand, Scoutetten, Blandin, Velpeau, and many others. It has been applied by Guthrie to the amputation at the shoulder joint, and by several others to the removal of the bones of the carpus and tarsus, to which it is well adapted. Scoutetten has furnished a critical examination of its advantages, and has proposed to apply it to several cases in preference to the ordinary methods of amputating.

The chief peculiarity of the oval method is, that the incision is made from without inwards, and is carried obliquely round the member so as to represent the letter V inverted, the acute angle being directed upwards, and the obtuse portion downwards. Thus, in amputating at the shoulder joint by this method, the acute extremity corresponds to the acromian process of the scapula, while the obtuse extremity passes along the axillary face of the arm, the two limbs being situated, one in front, and the other behind the shoulder joint, round which the whole incision is carried in an oblique direction.

It is sometimes performed by two cuts. By the first, the integuments are divided completely round the member, and after they have been retracted, the muscles are divided by a second sweep down to the bone. Some operators, however, accomplish the division of the whole of the soft parts by the first cut. The former method should be preferred at the shoulder, or wherever the member to be amputated is voluminous.

Whichever method be adopted, the upper part of the incision should extend a little above the point at which the bone is to be sawed, and ought, as a general rule, to occupy the part of the member upon which the soft parts present the least thickness.

The different modifications of this method will be described with the individual amputations, when the cases to which it is more especially applicable will be pointed out.

§ 12. *Management of the bleeding vessels after the removal of the member* By whatever method the operation is performed, the first object that claims the attention of the surgeon, after the removal of the member, is the bleeding vessels. It has been already stated that the ancients, though certainly not entirely ignorant of the use of the ligature, relied principally upon cauteries and styptics for the purpose

of arresting the hemorrhage which succeeds amputation. Since the advantages of the ligature have been determined, these caustics, and styptics, the white agaric, and a variety of means formerly employed, have been entirely abandoned. They cannot be relied upon, and produce much injury when applied to the face of the stump, by destroying or diminishing its capability to unite by the first intention. The same objections hold good against the styptic solutions and powders which have been recently recommended by Binelli, Talrich, Halma-Grand, and Bonafoux. They have been found adequate to arrest the flow of blood in animals, but it is questionable whether they would succeed in man; and even admitting their adequacy, they should not be employed, for the reason assigned above. The same detrimental effects, as regards union by the first intention, are produced by the alum cut into a cone, and introduced into the extremity of the vessel, which has been found successful in commanding the flow of blood.

The ligature is the most appropriate, and, indeed, the only means that can be securely relied on, for commanding the hemorrhage from large arteries. The material most generally employed for ligatures is common sewing-silk, but various other articles have been adopted; as soft leather, cat-gut, the intestines of the silk-worm, French kid, buck-skin, &c. It is stated that strips of leather were employed by Ruysch for securing the artery in operating for aneurism; but to Dr. Physick, to whom American Surgery is so much indebted, the credit of introducing the use of animal ligatures is unquestionably due. He uses for this purpose, small slips of French kid rolled into the proper shape, which are applied to the vessel in the usual manner, and cut off close to the knot. The great advantage of these ligatures is, that being composed of an animal substance which becomes readily dissolved in the discharges of the wound, they are either thrown off with them, or absorbed. From this cause, they excite less irritation than those made of silk, and are consequently more advantageous where union by the first intention is desirable. This practice has been much employed by American surgeons, and also by some of the English. Dr. Jameson speaks favourably of buck-skin ligatures; and Norman, Sir A. Cooper, and some other English surgeons, have obtained very satisfactory results from the use of catgut. The animal ligatures were also employed in France, by Beclard. It is proper to state, however, that in some instances where they have been applied to large vessels, they have been dissolved before the obliteration of the vessel was obtained, and secondary hemorrhage has ensued. On account of an apprehension of this accident, many surgeons do not employ them, except for vessels of small size, and this is doubtless the safest practice.

As regards the size and shape of the silk ligatures, much difference has existed in practice. Before Jones and others insisted upon the necessity of dividing the two inner coats of the artery by the constriction of the ligature, those of larger size were employed. The English surgeons generally used several threads of silk, twisted together to make them round, while the French so disposed the threads as to make the ligature flat. Scarpa employed small flat bobbin, and interposed between it and the vessel, a small roll of adhesive plaster, to prevent its coats from being injured, and to bring the inner surface of the walls more accurately in contact.

These large ligatures, acting as they do like a foreign substance, generally excite considerable irritation and suppuration, and thereby prevent immediate union. To obviate these effects, it was long since proposed to cut off one end close to the knot: a practice which is now very generally adopted. With a view of correcting the evil still more effectually, it was proposed by Veitch, as early as 1806, (*Edinb. Med. and Surg. Journ.* II.) to tie the bleeding vessels with a single thread of fine silk, and to cut off one end close to the knot. An attempt has indeed been made to carry this practice still farther:—to use a single thread of fine dentist's silk, and to cut away both ends, merely leaving the knot and loop which include the vessel. The first printed account, according to Hennen, (*Military Surgery*, 2d ed. p. 183. Edinb. 1829.) of the practice of removing both ends of the ligature, was furnished by Launcelot Haire, a surgeon of Essex. It has since been recommended by Hennen, Maxwell, Wilson, Watson, Delpech, Lawrence, and others. The last named gentleman, besides advising the ends of the ligatures to be cut off, commends the employment of a single thread of fine dentist's silk. (*Med. Chirurg. Transactions*, VI.)

It must not be concealed, however, that notwithstanding this procedure has frequently succeeded very well, the knot of silk has sometimes given rise to the formation of abscesses and troublesome suppuration. Cases of this kind have been reported by Cross, Downing, and Guthrie;

and S. Cooper and Collier, although they adopted the plan here recommended with success, did not find it more advantageous than the common method. In Germany, it has been condemned by Schreger, Walther, Rust, and Grossheim, and at the present time it is not extensively employed in any country.

The plan recommended by Veitch, should be adopted for the smaller arteries, while for the principal trunks, a ligature composed of two or more threads may be employed. One end should always be cut close to the knot, and when several ligatures are applied, the remaining ends should be brought out at the nearest angle of the wound; or if one or more of them be placed in the centre of the stump, they may be brought out at the nearest point between the adhesive strips. Roux, who adopts the practice of uniting the stump by the second intention, recommends all the ligatures to be brought out at the lower angle of the wound, because, in that situation, they will form a kind of drain for the escape of the discharges. The plan advised above will be much less objectionable, as creating fewer obstacles to the healing of the stump.

To draw out the extremity of the bleeding vessel for the purpose of tying it, some surgeons prefer the tenaculum of Bromfield, while others employ the artery forceps. We have generally found the former the most convenient instrument. The point ought to be very sharp, and well polished. The end of the vessel should be cautiously transfixed, without including any of the adjacent structures, and then slightly drawn out, so as to permit the assistant to fix the loop of the ligature upon it. When this is accomplished, the two ends are to be cautiously drawn, while with the point of the index finger, the slip of the loop is pressed down upon the vessel. It should always be secured by a double knot, and particular care be taken not to include the vein or the accompanying nerves. The principal artery being secured, those of smaller size are to be sought by gently sponging away the blood and slacking the tourniquet or diminishing the compression. Every vessel that bleeds must be secured; for although it is a bad practice to apply too many ligatures, it is still more so, to be obliged, after the stump has been dressed, to open it on account of secondary hemorrhage, or to expose the patient to the irritation and suppuration likely to arise from an accumulation and confinement of grumous blood.

Sometimes considerable venous hemorrhage takes place, which is difficult to control. To overcome this difficulty, it has been proposed by Desault, Hey, and Graefe, to include the artery and vein in the same ligature, by passing one point of the forceps into the mouth of each vessel, and drawing them out together. Hennen also states, that he has frequently tied the vein, without any bad consequences. In some instances, however, in which this practice has been adopted, an alarming phlebitis has taken place, and destroyed the patient. It is always hazardous, and should not be resorted to, except from urgent necessity. Very alarming effects have also resulted from including the nerve in the ligature, and in some cases it has given rise to tetanus.

When, as is sometimes the case, considerable hemorrhage takes place from the nutritious artery of the bone, it should be arrested by the introduction of a small plug of wax or soft wood, by a lint compress, or, what will generally be effectual, by twisting or lacerating the mouth of the vessel with the points of the forceps.

When merely a slight oozing continues after the arteries have been tied, the stump should be sponged with cold water. Astringents ought never to be employed under such circumstances. They irritate the wound, excite inflammation, and create an obstacle to immediate union. If a small vessel bleeds, it should be secured, and time must be allowed for the energies of the patient to rally from the shock of the operation: for it frequently happens, that after reaction commences, many vessels which did not previously pour out blood, bleed profusely, and render it necessary to open the stump. To obviate this, some surgeons, as Parrish, Klein, Dupuytren, Lisfranc, and others, have proposed to leave the stump open for some time after the operation: a practice which we have seen adopted with advantage, not only as a precautionary means against hemorrhage, but likewise, as we are inclined to think, in facilitating union by the first intention.

Other means of arresting hemorrhage have been proposed. One of these is torsion of the extremity of the vessel, which has within the last few years excited considerable attention amongst the French surgeons. It is stated by Velpeau, that he was led to this discovery in 1826, by some experiments made on dogs; but it appears that he did not apply it to the human subject, until the 13th November, 1828. A warm discussion has been carried on between this surgeon and Amussat,

relative to their claims to priority in this alleged discovery. A reference to the labours of their predecessors and contemporaries would have convinced them that there is no novelty in the procedure recommended by them. Torsion has been repeatedly employed by surgeons for the purpose of arresting hemorrhage from small arteries. It was put in execution by Dr. BUSHE of New-York, in a case of amputation of the thigh, which he performed in December 1826. He arrested the hemorrhage from all the vessels, except the femoral, (four in number,) by twisting the cut extremities in a square-beaked forceps, furnished with a sliding bar and two nuts. In 1827, he adopted the same procedure in an amputation of the thigh, one of the forearm, one of the foot, and in a case of extirpation of the testicle. In July 1828, it was again practised by him in an amputation of the thigh. All these operations, it will be seen, date anterior to that practised by VELPEAU, and if torsion of the arteries were to be regarded as a modern discovery, the merit would be certainly due to Dr. BUSHE, in preference to the French surgeons. But he does not claim the honour. He states that both GALEN, and GUY DE CHAULIAC, recommend torsion, and cites from the former author the following passage to prove the correctness of the assertion: "Quinimo si vas unde profluit altē sit demissum, certius ipsius tum positum intelligat tum etiam magnitudinem, prætereria venane sit an arteria; post hæc, *injecto unco, attollat ac modicè intorqueat.*" (*New-York Med. Chirurg. Bullet.* II. p. 212. 1832.)

Since 1828, torsion for the purpose of arresting hemorrhage has been practised to a considerable extent in France, Germany, England, and America, and although it has been found successful, the result has proved that it possesses no advantages over the ligature, and that it is much less safe. It ought never to be confided in where the vessel is large, and should, if employed at all, be confined to arteries of small calibre.

To accomplish the torsion, the divided end of the vessel is to be seized and drawn out with a pair of artery forceps, furnished with a slide or spring, taking care to have it separated from the other structures. A second pair of forceps is then to be fixed on the vessel in the bottom of the wound, so as to grasp it in a transverse direction, with which it is to be supported, while seven or eight turns are made upon its extremity with the first instrument; or the artery may be held between the nails of the index finger and thumb, while torsion is made with the forceps. This method, recommended by VELPEAU, is more simple than those proposed by AMUSSAT and KLUGE, and is equally effectual. AMUSSAT employs two forceps with elongated rounded blades: one to draw out and twist the vessel, while the other is used to support it in the bottom of the wound.

Contusing or lacerating the cut end of the small vessels with the tenaculum or forceps will often be found sufficient to stop them from discharging blood. But this procedure should never be relied on, except for such branches as are too small to require the ligature, and which merely give rise to a slight oozing.

It has even been proposed to dispense with the ligature and all the usual means of arresting hemorrhage after amputation, and to rely upon compression applied upon the course of the principal vessel. KOCH, surgeon of the Hospital of Munich, states that he has adopted this practice for more than twenty years. He merely applies a graduated compress upon the course of the principal arterial trunk, and confines it by means of a roller bandage extending from the stump to the trunk of the body. He then approximates the wound, and heals it by the first intention. The same success has not attended this procedure in the hands of other surgeons, and we think it should never be imitated.

When the artery is so profoundly embedded in the soft parts as to render it impossible to isolate and draw it out sufficiently to apply the ligature, a common curved needle armed with three or four threads of silk should be introduced into the soft parts first on one, and then on the other side of the vessel, and the ligature drawn so as to include a part of them, together with the artery. Should the artery be so much ossified as to be incapable of sustaining the ligature applied in the usual manner, a cone of soft buck-skin large enough to fill its cavity may be passed into its orifice, and there secured by a soft flat ligature of the same substance, tied around the vessel in the usual manner.

The plan proposed by VELPEAU, of reverting the extremity of the artery, and thrusting it into the soft parts, is unsafe, and as it secures no advantages, ought never to be employed, except for very small vessels.

§ 13. *Dressing the Stump.* After all the vessels have been secured, and the oozing from the stump has ceased, all coagula of blood should be carefully sponged away, and the parts wiped dry with a

soft towel; the surgeon should then assort the ligatures, and place them in the situation which he wishes them to occupy, arranging those which are nearest the circumference so that they may be placed in the angles of the wound, and bringing out the others in the centre. The edges of the flaps must next be brought together, and maintained in their proper situation. But in this stage of the dressing, a different procedure must be adopted, according as it is proposed to obtain immediate or secondary union.

When the surgeon is desirous of uniting the stump by the first intention, it is important that the corresponding surfaces of the flaps should be brought in accurate contact, and that no foreign substance be interposed. If the silk ligatures be used, one end should be cut close to the knot, as already directed, and if chamois leather or buckskin, nothing but the knot itself should be left. Coagula of blood must also be carefully removed; for if suffered to remain between the faces of the stump, they always excite much irritation, and not unfrequently give rise to suppuration. The edges of the skin, being neatly approximated in a line corresponding to the direction of the flaps, when the operation is performed in that manner, are to be confined with strips of adhesive plaster, which are to be brought over the end of the stump, and placed so as to leave sufficient space between each for the escape of the discharges. It was formerly the practice to use sutures for this purpose, and although they have been abandoned by most modern surgeons, there are still some who continue to employ them. Graefe uses a single suture of flat bobbin, or narrow tape. Sutures have also been highly recommended in modern times by Hey, Benedict, and Delpech. We have never found them necessary, and in one case in which we employed them in a flap amputation of the leg, they did considerable mischief.

After the adhesive stripes have been applied, a piece of lint spread with simple cerate should be laid over the face of the stump. To furnish additional support, a roller bandage must next be applied so as to extend from the stump some distance up the member. This may be applied by laying one end longitudinally upon the limb, and carrying the bandage, by reversing it in opposite directions, over the face of the stump, so as to form a cross, and ascending with it by spiral turns to the necessary height. By Alanson, and Louis, the first turns of the bandage were made upon the trunk, whence it was carried downwards by circular turns to the base of the stump. This practice is also recommended by Richerand, and S. Cooper, with the view of bringing the muscles more completely over the face of the bone.

The masses of lint, compresses, the malta cross, the woollen cap, and a variety of means formerly employed, are neither necessary nor proper. The wound must be kept cool, and should be as little encumbered as possible, and the more simple the dressings, provided they serve to keep the edges of the wound in contact, the better. This principle is now acknowledged by the best English, American, and German surgeons, and ought never to be neglected.

Some difference of opinion has existed in relation to the direction that should be given to the line formed by the juxtaposition of the flaps or integuments. In most cases this must be determined by the manner in which the flaps are formed, the configuration of the member, &c.; but in amputation of the thigh by the circular incision, the line of union may be either made transversely, perpendicularly, or in a diagonal direction. Each of these methods has had its advocates, but if union is to be obtained by the first intention, it is of little consequence which is adopted. Alanson recommended the first, and it has been followed by a majority of English surgeons. Hutchinson has insisted much upon its advantages, on account of the tendency the pressure of the limb will have, when laid upon a pillow, if the line of union is made perpendicular, to force asunder the inferior or posterior angle of the wound. It is also recommended by Graefe. Most surgeons on the continent, however, unite the wound so as to form a line from before backwards, and this method not only admits of a more accurate approximation of the soft parts, but when suppuration takes place, allows a more ready egress to the discharges.

The stump being dressed, the patient must be put to bed, and the member fixed upon a pillow in such a manner that the parts remote from the wound shall bear the greater part of the pressure. A mattress should be preferred to a feather bed, and when it is desirous to keep the stump wet with cold water, a practice in general use among the Spanish surgeons, and which we have used with advantage, the pillow may be covered with soft oiled silk.

When it is the object of the surgeon to obtain *mediate*, *consecutive*, or what has been generally denominated *union by the second intention*, the dressings must be somewhat different. In such cases it is

customary to fill the face of the stump with lint, or some other substance, to prevent the parts from uniting, until the processes of suppuration and granulation have become completely established. Some even have used for this purpose pieces of sponge or agaric, which are interposed between the flaps, so as to keep them from coming in contact. Whichever of these materials are employed, after the cavity of the wound has been thus filled, the soft parts are brought over and confined in the manner directed above. Where secondary union is determined upon, a better method will be that practised by Dr. PHYSICK, and recommended by DORSEY, of merely interposing a thin pledget of lint between the edges of the wound, so as to prevent the skin from adhering. (*Elements of Surgery*. II. 301. Philad. 1818.)

Few questions relating to surgical practice have given rise to more discussion than that of the comparative advantages of immediate and consecutive union after amputation. In former times it was conceived to be a highly hazardous procedure to attempt to unite the edges of the wound by the first intention. It was considered indispensably necessary that the parts should be allowed to disgorge themselves freely by a profuse suppurative drain established from the face of the stump; that the end of the bone should be allowed to exfoliate, and that the system should have time to accommodate itself to the new condition of the member, and to the changes which take place in the distribution of the circulating fluids subsequent to the operation. From these and other motives, many of the surgeons of the continent, especially the French, still insist upon the advantages of uniting the stump by granulation; and some of them even affirm that amputations thus treated are more successful than those in which immediate union is attempted. It has been urged, that when the latter practice is adopted, the blood which oozes from the smaller vessels is confined in the bottom of the wound, and gives rise to troublesome suppuration and the development of deep sinuses; that the patient is more exposed to extensive constitutional disturbance and tetanus; and that where the amputation has been practised for a disease of long standing, the internal organs are apt to become extensively diseased, or even the seat of purulent abscesses. The English surgeons, on the contrary, by whom the practice of immediate union was first instituted, and who have adopted it as a constant rule of conduct, deny the validity of these objections, and claim for their procedure advantages which far more than counterbalance any difficulties incurred by it. The cure is more speedily accomplished; the individual is saved from the long-protracted pain, suppuration, and hectic fever, which are occasioned by keeping the stump open; the bone is not so apt to protrude, and become necrosed; the soft parts retract less; and a conical stump, which is so frequent a consequence of the opposite practice, is seldom developed. The extensive and daily experience of the English and American surgeons, by whom immediate union is advocated, has fully demonstrated these advantages; and from the opportunities which we have had in witnessing the comparative merits of the two procedures, in the French and English hospitals, and in America, we have no hesitation in asserting that the advantages are decidedly in favour of immediate union. No feature in French surgery struck us as being so palpably bad as the treatment of amputations, and we saw no operations so unsuccessful. Individuals of good constitutions, not unfrequently were submitted to protracted suffering and wasting suppuration, from keeping the stump open, when it might have been healed in three weeks; and in some instances, we are inclined to think, that an irritable and gleety stump, with severe constitutional disturbance, terminating in death, were developed by filling the wound with lint, under circumstances where a successful issue might have been readily secured by the adoption of an opposite course.

From a faithful survey of the whole grounds, we would lay it down as a rule, that immediate union should be attempted in all cases where the structures are healthy, and not in a sloughy condition. We are not sensible of any bad effects that can possibly result from it. We may sometimes fail in accomplishing it; but even then we lose nothing by the attempt; for suppuration and granulation will take place, and we shall have as many facilities for accomplishing union by the second intention, as we should if we had sought it from the first. Even when the parts are not entirely healthy, they ought to be placed as nearly as possible in apposition, taking care not to constrict them with the strips and bandages. Leeches, poultices, or stimulating applications, according to the circumstances of the case, can be as well applied with the stump in that condition, as when its edges are forced asunder by lint; and if we should merely succeed in obtaining union to a limited extent, the ad-

vantage will be considerable, as the part to be healed by granulation will be thereby diminished. Nor do we conceive consecutive union necessary, where the amputated member has become a kind of habitual drain, inasmuch as by appropriate constitutional treatment, together with the establishment of a seton or issue at some other point, any mischievous consequences which would be apt to ensue may be obviated.

The second dressing should, under ordinary circumstances, be deferred to the fifth or sixth day. But in some instances, where considerable oozing of blood takes place from the vessels after the stump has been dressed, it becomes confined within the bottom of the wound, and acquires such offensive or irritating qualities as to render it necessary to remove the first dressings at an earlier period.

As the first dressings are generally very firmly agglutinated with each other, in consequence of their being saturated with blood, and its subsequent drying, great care must be taken in the removal of them, not to tear up any adhesions of the edges of the wound which may have formed, and to avoid inflicting unnecessary pain upon the patient. To facilitate their detachment, they should be carefully softened by throwing a gentle stream of tepid water upon them, until they will separate easily; and while the surgeon removes them, an assistant should carefully support the stump, making a gentle pressure against its sides, to prevent the edges from separating. After the roller and pledgets of lint have been removed, if the stump is large, it will be advisable to remove only one adhesive strip at a time, supplying its place with a new one, before the next is detached, thus obviating the necessity of suddenly depriving the stump of all its support. After the stump has been cleansed with a soft sponge, or a dossil of lint, and wiped dry with soft linen, the adhesive strips must be applied as before. Over them should be laid a pledget of lint spread with cerate, or spermaceti ointment, and the whole confined by a roller, as in the first dressing. The subsequent dressings must be managed upon the same principles, and should be renewed as often as the circumstances of the case may require. The ligatures come away at different periods. Those of the small arteries generally become loose about the fifth or sixth day, and those of the principal trunks, about the tenth or twelfth. Sometimes, however, they are retained for several weeks, and keep up more or less suppuration in the vicinity. After sufficient time has elapsed for them to become detached, very gentle traction should be made at each dressing, taking care never to use sufficient violence to tear them away. Should they not become loose in the course of two or three weeks, they may be cut away by means of a small, beaked knife, having a slight notch or groove upon the beak to direct it along the course of the thread.

§ 14. *Accidents consecutive to Amputation.* a. *Hemorrhage.* It not unfrequently happens that more or less bleeding takes place from the stump after the dressings have been applied, even though all the vessels which poured out blood at the time of the operation may have been secured. This arises from the renewal of the energy of the circulation, which takes place after the system has had sufficient time to recover from the depressing influence inflicted upon it by the shock of the operation. To obviate this occurrence, it will always be proper to delay some time before the dressings are applied, so that any small vessels which may be capable of pouring out blood, after reaction has taken place, may be discovered and secured. Another cause of *immediate consecutive* hemorrhage is the slipping of the ligature, in consequence of its not having been properly secured upon the vessel, or a division of the tunics of the latter by the ligature, in consequence of their having lost their natural powers of resistance from the influence of disease. It, moreover, sometimes happens, that after the expiration of several hours, a kind of vital erethism is excited in the stump, which disposes the capillaries to pour out blood in such profusion as to demand the attention of the surgeon. Considerable hemorrhage may also take place from the veins, in consequence of the bandages being applied so tightly upon the limb as to interrupt the free return of the blood through those vessels; and it has been asserted by Hey, that in some instances he has seen the same effect produced by a circular constriction of the integuments above the stump, requiring them to be divided on each side. We much question, however, if such a condition is ever likely to be developed in a sufficient degree to obstruct the passage of the blood through the veins.

From whichever of these causes the hemorrhage proceeds, we should never open the stump, except where the necessity is absolute. That operation is always productive of extreme pain, and is regarded by the patient with horror. In most

cases, where the bleeding is not profuse, it will merely be necessary to remove the roller and compresses, to slightly elevate the stump, and expose it freely to the cool air, or to keep it wet with cold water, or covered with ice. If the hemorrhage is venous, the simple removal of the bandage will generally be sufficient; and we have several times seen considerable arterial bleeding, where it proceeded from small vessels, arrested by uncovering the stump, and exposing it to the air, or wetting it with cold water. Should these means not prove efficient, pressure must be made upon the course of the principal artery of the limb, by means of a *press artery*, a properly arranged compress, or a tourniquet so adjusted as to compress the vessel, without interrupting the return of the venous blood. In some instances, pressure, kept up for the short space of ten minutes, by means of the thumb, or some convenient instrument, fixed upon the course of the main artery, will effectually command the bleeding. When the hemorrhage is more profuse, and cannot be commanded by any of these means, the stump must be opened. If the accident occur shortly after the operation, it will be easy to secure the bleeding vessel. But if this cannot be done, it may sometimes be commanded by means of a piece of soft sponge, or agaric, confined for some time upon the extremity of the artery.

Hemorrhage sometimes takes place from the stump at a much later period, and proceeds from a very different cause. From a want of a proper degree of plastic power in its tunics, the vessels take on ulceration at the point at which they are included in the ligature, or they become affected by a kind of sloughing process, by which the ligature is thrown off before obliteration can be accomplished. This latter condition is especially apt to occur after amputations which have been performed during the progress of gangrene, in consequence of the structures above the limits of the dead parts having taken on something of the gangrenous tendency. The ulcerative condition is particularly liable to take place where the artery is affected with ossification, or any one of the forms of degeneration to which it is liable. It likewise supervenes in many instances, from a preternatural softening or fragility of the arterial tunics.

Consecutive hemorrhage, resulting from these causes, generally occurs at an advanced period; seldom before the tenth or twelfth day, and frequently after the third week. It is always a formidable accident, and difficult of management. The ligature to the orifice of the bleeding vessel is no longer practicable, except by including a portion of the soft parts, as was done in one case by SANSON, after separating them with a stroke of the bistoury from their surrounding attachments. PETIT invented a kind of tourniquet, by which he was enabled to confine a piece of sponge or agaric upon the extremity of the vessel so as to command the hemorrhage; but it has not been found of sufficient utility to insure its employment by modern surgeons. The same materials, however, may sometimes be advantageously bound upon the part, by means of a compress and roller, properly adjusted upon the limb. It will also be proper to apply compression upon the course of the artery, in the manner prescribed above, or by means of a compress and bandage. Should all these means fail, the only resource left for the surgeon, is to cut down upon the course of the main arterial trunk, some distance above the stump, and secure it in a ligature, as in the treatment of aneurism. This operation has been particularly recommended by ROUX, who has practised it several times with success, and it has also been employed advantageously by DUPUYTREN, DELPECH, SONNÉ and others. It should, nevertheless, be stated, that in some instances, the ligature of the vessel has not arrested the flow of blood, the latter being kept up by the anastomosing vessels. BLANDIN met with a case in which this was observed, and HEY and GUTHRIE represent that it will not always succeed.

GOURAUD has indicated a form of consecutive hemorrhage produced by the necrosis of the end of the bone. At each dressing, there is an oozing of blood from between the dead and the living parts, which cannot be arrested, either by compression, or any other procedure, except the resection of the dead parts. (VELPEAU, p. 348.) We have witnessed an example of hemorrhage from this cause, after an amputation of the leg, where the whole stump had healed, except a small fistulous opening in the vicinity of the fibula. On one occasion, a profuse hemorrhage took place from that aperture, and on examining it, the end of the bone was found dead and detached from the shaft. It was drawn away with a pair of dressing forceps, and the bleeding did not recur.

b. *Phlebitis.* The inflammation of the veins which sometimes succeeds amputation, is by far, one of the most formidable accidents to which the individual is exposed. It gives rise to an alarming dis-

turbance of the natural acts of the system, and by becoming extensively diffused, frequently destroys the life of the patient. These disturbances constitute a train of phenomena, which similate very closely the characters of a malignant fever, consisting of small, frequent, irritable pulse, a pungent or burning heat of the skin, terminating in profuse clammy sweats, stupor or delirium, dark dry tongue, great prostration of strength,—in short, all the symptoms which mark the worst forms of fever. The stump becomes somewhat tense and swollen, and the torture inflicted by the removal of the dressings is almost insufferable. Its surface becomes gleety, or is covered by a viscid, grayish-coloured matter. All healthy suppuration is suspended, and if partial adhesions have formed, they are broken up, and the bone becomes exposed. A diffused tenderness and burning pain are frequently extended along the member, especially in the track of the principal vessels, and not unfrequently there is more or less tumefaction of the whole limb.

All these accidents have been long familiar to most surgeons, but they were at a loss to explain their source. The most rational solution that for a long time suggested itself, was, that they are excited by the free absorption of purulent matter from the face of the stump, and its subsequent diffusion with the mass of the circulating fluids, to various and remote parts of the system. It is certainly true, that the injection of certain substances into the veins produces a train of phenomena precisely similar; but it is only in modern times we have been taught, that all these symptoms or consequences are the result of the development of an inflammation of the veins. These vessels are not only found inflamed in the immediate vicinity of the stump, but exhibit strong traces of the same condition in various and isolated portions of the system. Hence, the opinion which attributed the mischievous consequences to the direct extension of the disease along the tunics of the vessel towards the heart, cannot be sustained; but it is far more probable, as has been maintained by Velpeau, and many of the French pathologists, that the alarming condition in question may be with more propriety attributed to the pus mingling itself with the blood, and being with it transported into the various organs of the economy, irritating the internal surface of the vascular system, exciting inflammation and suppuration at various points, and developing all those phenomena which have been shown by experiment to be produced by the injection of putrid and irritating substances into the veins.

c. *Purulent deposits in the organs.* Very intimately connected with the accident just described, is the development of purulent deposits in different tissues and organs, after amputation. These collections were long since noticed by Quesnay, who did not, however, properly understand their character. Within a few years, they have been carefully investigated by Blandin, Marechal, Dance, Ribes, Velpeau, and others, who, although not in accordance with each other in their conclusions, have elicited much useful information.

They may take place in any of the organs or tissues, but are most frequently met with in the lungs, liver, spleen, beneath the serous and mucous surfaces, and in the cellular tissue. Their size varies from a mere point up to a large excavation, similar to those which are occasioned by the disorganization of a mass of crude tubercles. They have, indeed, when seated in the lungs, been often confounded with tuberculous degeneration: hence it has often been inferred, that the death of the patient has been rather occasioned by that disease, than by the consequences of the operation.

Different conjectures have been offered in relation to the manner in which these deposits are formed. Quesnay supposed, that the pus existing already formed within the arteries, was deposited by them in different situations. Ribes, Velpeau, and Marechal, have maintained that the matter is first developed within the stump, and then taken up by veins or lymphatics, and transported to the points at which the depositions are made. Others have attributed its formation to phlebitis, and Blandin ascribes it to local inflammation taking place in the substance of the organs or tissues, and concurs with Dance in the belief, that the blood, rendered more fluid by commingling with the pus, becomes extravasated into the interstices of the cellular tissue, and into the substance of the organs, there giving rise to a limited ecchymosis, or a number of minute petechiæ, which, under the influence of a particular form of inflammation, finally terminates in suppuration. Be this as it may, it is certain that phlebitis has more or less participation in the condition, and it is seldom that one is seen without the precedence or existence of the other. (*Dict. de Med. et de Chirurg. Prat.* II. 227.) (See *Abscess, metastatic.*)

d. *Abscesses and sinuses of the stump and limb.* The abscesses which form after amputation differ in no essential particular from those which are ordinarily developed

under other circumstances. Sometimes the edges of the flaps unite by adhesive inflammation, while the bottom of the wound takes on suppuration, and the matter being unable to escape, accumulates so as to form an abscess. Caries or necrosis of the bone, the irritating influence of the ligature, &c., also conspire to excite suppurative inflammation, and to favour the development of these abscesses. Sometimes, when the purulent accumulation is considerable, and the matter cannot escape, it travels along the limb in the interstices of the muscles, or in the course of the synovial sheaths, and thus occasions extensive burrowing sinuses. The latter accident is more apt to occur after amputation at the wrist, or through the articulations of the tarsus, and in many instances it has occasioned very disastrous consequences, rendering it necessary to make numerous incisions and counter openings to give exit to the matter. This should always be done as soon as an abscess has formed in a stump, whether it be small or large, and if the pus has a free outlet, there need not be much apprehension entertained of its retarding the cure, unless there be some local cause to keep up the irritation.

e. *Caries and Necrosis of the Bone.* It was formerly supposed, that the injury inflicted on the bone by the action of the saw, would almost necessarily give rise to a subsequent exfoliation or necrosis of its substance; and the practice which was generally adopted, of keeping the stump in a perpetual state of irritation by improper dressings, and of maintaining a long-continued suppuration, could not fail to render it of frequent occurrence. Under the more rational course pursued by modern surgeons, death of the end of the bone after amputation, is much more rarely met with than formerly. It may nevertheless take place under any method of treatment, and may proceed from several causes. The injury inflicted upon the bone itself will sometimes so far impair its vital powers, as to render it incapable of sustaining the integrity of its structure. A laceration or detachment of the periosteum may also occasion the death of the bone, and the same consequence not unfrequently ensues from its extremity not being sufficiently covered with the soft parts. This sometimes takes place even after the stump has cicatrized, in consequence of the integuments retracting so much as to press the cicatrix against the end of the bone. Under these circumstances, the cicatrix generally ulcerates, and exposes the end of the bone, which, being unprotected, exfoliates, or becomes affected with necrosis. This result may be generally prevented by the application of a bandage, which should be so adjusted as to counteract the contraction of the muscles, and thereby diminish the pressure upon the cicatrix.

There is still another cause of the death of the bone, which has not until lately attracted the attention of surgeons. It is the inflammation of the marrow, or more properly of the medullary membrane. It was noticed by Ribes, Guthrie, Cruveilhier, and Beclard, but was not particularly described until Renaud published a memoir on the subject in the *Archives de Médecine.* This inflammation, it appears from various facts cited by him, determines the death of the corresponding portion of the bone, a detachment of the periosteum to an extent corresponding with that of the disease, and the development of purulent deposits in the vicinity. In the cases observed by Renaud, there was a general doughy feel of the stump without apparent inflammation, a free discharge of pus on pressure, acute pain after the first dressings, and in several instances, a yellowish suffusion of the stump, and of the wound. (J. Cloquet, *Dict. de Méd.* 2d ed. II. 455.)

It sometimes happens, after amputation of the leg below the knee, that the weight of the soft parts of the calf of the leg drags so forcibly upon the skin, which occupies the angle of the tibia, that it sloughs, and denudes the bone, which, being no longer covered and protected, takes on a carious or necrosed condition. This accident can be easily prevented by placing the member in such a position as to secure a proper support for the soft parts, and prevent them from exercising so much traction in the direction designated.

When caries or necrosis of the bones of the stump takes place, it will seldom be necessary for the surgeon to do more than to secure a free exit for the discharges, and to pick away any pieces of bone as soon as they become detached. The application of cauteries and escharotics, so much resorted to by the older surgeons, has been properly laid aside by modern practitioners of the art. Nor will it be necessary to saw through the bone higher up, except where the protrusion is so considerable as to expose a great extent of its surface, and thus render it impracticable to cover it with the soft parts after the dead portion is detached. In some instances, however, this painful operation will become necessary, and in executing it, great care should be taken to detach the muscles from the

bone to a sufficient extent to furnish an adequate covering for the latter.

f. *Conical Stump.* This accident is generally complicated with the preceding. It generally arises from a neglect of the precaution to preserve a sufficiency of the muscles and integuments to completely cover the bone; from the latter being sawed too low; from carelessness in the application of dressings, or the frequent employment of such as are of a highly irritating character; the preternatural contraction of the superficial stratum of muscles; and, above all, a sloughing of the soft parts, by which the bone is left bare and prominent. It was of frequent occurrence in the hands of the older surgeons, but since the improvements which have been made in modern times in the method of performing amputation, and treating the stump after the operation, it is rarely met with. It is now seldom seen in practice, except as a consequence of some fault in the performance of the operation, or mismanagement or neglect in the after treatment. The practice of healing the stump by the first intention has greatly diminished its frequency, and if proper precaution be observed in executing the operation, and conducting the subsequent dressings, it cannot take place except as a consequence of extensive sloughing of the muscles and integuments. Although it occurs most frequently before the stump is healed, it is sometimes developed after it has become wholly united,—the retraction of the muscles drawing the cicatrix so forcibly over the end of the stump, that ulceration or sloughing of the new skin takes place, and the bone protrudes.

To obviate the occurrence of this condition, which, when it takes place, is always a source of distress to the patient, and, in a majority of instances, of discredit to the surgeon, the rules which have been laid down above for the performance of the operation, should never be neglected; and, to prevent the inordinate retraction of the muscles from occurring, they must be confined, and fairly drawn over the end of the bone by the proper adjustment of a roller bandage, extended from above downwards, as recommended by Louis, Alanson, and Richerand. If, after the bone has been sawed, it is found that it cannot be properly covered with the soft parts, it will be better, as suggested by Guthrie, to proceed at once to divide it higher up, than to be obliged afterwards to submit the patient to all the pains and horrors of secondary amputation.

Should the bone protrude, notwithstanding all the means used to prevent it, the subsequent treatment must be dictated by the condition of the stump. Where the protrusion is slight, it may be safely left to nature, the surgeon contenting himself with the removal of the carious or dead bone, as soon as it becomes detached; but where so much of the bone is exposed as to render it impracticable to cover it with soft parts, after its dead portion is separated, it will become necessary to resort to resection, or secondary amputation. Sabatier particularly recommends this procedure, and represents, that although he had repeatedly sawed off the end of the bone, no bad consequences ensued. In several instances, however, in which secondary amputation has been performed by other surgeons, the cases have had a fatal termination.

g. *Gangrene and sloughing of the stump.* Where amputation is performed upon a part of a member not altogether healthy, or upon an individual of feeble constitution or intemperate habits, the muscles and integuments are apt to become gangrenous and slough away. We have already adverted to this accident as one of the causes of protrusion of the bone, and where it does not produce that effect, it always retards the cure. It must be treated upon the general principles which regulate the management of a similar condition taking place under other circumstances. In camps and crowded hospitals, however, there is a species of gangrene of a far more formidable character, which prevails as an epidemic, and seizes upon every wound or injury which may happen to be brought within the sphere of its influence, and which, where it is prevalent, constitutes the principal cause of the failure of amputation in such situations. (See *Hospital Gangrene.*) Should the stump become affected with this condition, the speedy removal of the patient into a pure and salubrious atmosphere will furnish him almost the only chance of recovery. Should the soft parts become extensively involved, and the bone be laid bare by sloughing, amputation must be practised without delay, above the seat of the disease, even though the gangrene be still progressive. Success has sometimes been obtained by this course, even under the most unpromising circumstances, and the patient should never be resigned to his fate while there is a shadow of hope.

Various other accidents sometimes supervene upon amputation, which it will not be necessary to describe, as they must be treated upon general principles. They are

erysipelatous inflammation, spasms, tetanus, the re-development of the disease for the removal of which the member was amputated, &c.

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E. Geddings.

AMYGDALUS. (*Botany.*)

Sex. Syst. Icosandria Monogynia.—*Nat. Ord.* Amygdaleæ.

Gen. Ch. Calyx five-cleft, inferior. *Petals* five. *Drupe* with a nut perforated on its surface. Lindley.

1. *Amygdalus communis.—Almond-tree.—Amandier,* Fr.; *Gemeiner Mandelbaum,* Germ.—*Sp. Ch.* "Lower serratures of the leaves glandular. Flowers sessile in pairs." Lindley.—This is a small tree, about twenty feet high, with numerous spreading branches, which are covered with a brownish bark, except the young twigs, which are beautifully green. The leaves are alternate, petiolate, lanceolate, pointed, serrate with glands at the lower serratures, veined, three or four inches long, and of a bright green colour. The flowers are large, of a pale red colour varying to white, with very short peduncles, and are usually placed in numerous pairs upon the branches. The fruit is of the peach kind, with the outer covering thin, tough, dry, and marked with a longitudinal furrow, where it opens when fully ripe. Within this covering is an ovate, compressed, brittle shell, of a light brown colour, marked with pores on its outer surface, and inclosing an oblong-ovate, flat-

tish kernel, pointed at one end and rounded at the other.

There are several varieties of this species of Amygdalus, differing chiefly in the size and shape of the nut, the character of the shell, and the taste of the kernel. Two varieties are generally recognized by botanical writers—the *Amygdalus communis dulcis*, and the *Amygdalus communis amara*—the former bearing sweet, the latter bitter almonds. Some botanists consider these as distinct species, under the names of *A. dulcis* and *A. amara;* the former characterized by glands upon the petiole, and by the length of the styles greatly exceeding that of the stamens—the latter, by the absence of glands on the petiole, and by the length of the styles about equalling that of the stamens. The stem, moreover, of the bitter almond, is said by Hayne to be always lower, in its native country, than that of the sweet almond. Some botanists make a third species out of the soft-shelled variety, in which the petals scarcely exceed the calyx in length, and the shell of the nut is very thin and fragile. It is called *Amygdalus fragilis*, and coincides with the *dulcis* in this respect, that its kernel is always sweet.

The almond-tree has been long cultivated in various parts of the south of Europe, and grows wild in Greece, Syria, and Barbary. In the more northern parts of Europe, though it is occasionally cultivated, its fruit does not attain the same perfection as in the warmer latitudes. The trunk exudes a gum closely resembling that of the cherry-tree, with the property of swelling up and forming a soft viscid mass with water, but not dissolving in that liquid. The kernel of the nut is the officinal part. (See *Almonds.*)

2. *Amygdalus Persica.—Peach-tree.—Pêcher*, Fr.; *Pfirsichbaum*, Germ.—*Sp. Ch.* "Leaves with all the serratures acute. Flowers sessile, solitary." Lindley. The peach-tree is so well known that a detailed description would be superfluous. Linnæus divides this species of Amygdalus into two varieties—that with downy fruit, or the common peach, and that with smooth fruit, or the nectarine. The latter is by some botanists considered a distinct species; but it is asserted that both fruits have sometimes grown on the same tree, and even on the same branch, and one instance is mentioned of a single fruit partaking of the nature of both.

Though the native country of the peach-tree is not certainly known, it is generally believed to have been brought originally from Persia. It is cultivated in all parts of the civilized world where the climate is sufficiently temperate, but nowhere, perhaps, in greater abundance than in the United States.

A gum exudes from the stem, resembling that of the almond and cherry-trees; but it is employed for no useful purpose. The fruit constitutes an exceedingly grateful, and for most persons a wholesome article of food. It abounds in saccharine matter, which renders its juice susceptible of the vinous fermentation; and in some parts of this country a distilled liquor is prepared from it, called *peach brandy*, which by some persons is highly esteemed. The dried fruit is largely consumed in the form of pies, puddings, &c.; and, when stewed with sugar, is an excellent laxative article of diet, well adapted to cases of convalescence attended with torpid bowels. The officinal parts of the tree, are the leaves, the flowers, and the kernel of the fruit.

The *leaves*, as well as the *young twigs*, have the peculiar odour which characterizes various products of the genera *Amygdalus* and *Prunus*. Their taste is agreeably bitter, and somewhat austere. They yield by distillation a volatile oil similar to that of bitter almonds, upon which their odour and taste, as well as their medical virtues, chiefly depend. (See *Almonds.*) They are said to be laxative, and by some are at the same time considered astringent; but their powers, in either of these respects, are feeble and not to be relied on. As anthelmintics they have been employed with great reputed success. In the form of infusion, they are highly recommended in morbid irritability of the bladder and urethra. Half an ounce of the dried leaves are macerated in a pint of boiling water for three hours, and half a fluidounce of the tea given for a dose three times a day.

The *flowers*, including the calyx, should be collected before they are fully blown. They should be quickly dried, and kept in tin canisters excluded from the air and light. They have the characteristic aromatic odour before alluded to, which they retain to a certain extent when dried. Their taste is bitter like that of the leaves. They are gently laxative; and a syrup prepared from them is used to a considerable extent in Europe, in infantile cases. Like the leaves, they are also considered anthelmintic. A drachm of the dried flowers, or half an ounce of the fresh, given in infusion, is the dose as a vermifuge.

The *kernels*, though considerably smaller than bitter almonds, bear a close resemblance to them in appearance and properties, and probably in chemical constitution,

and might be substituted for them without disadvantage, in all cases to which the latter are applicable. In this country they are much used by the confectioners to flavour cakes and liqueurs.

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GEO. B. WOOD.

AMYLINE. (From ἀμυλον, starch.) *Amidine*, Fr. A yellowish-white, very friable, semi-transparent, inodorous, insipid substance, very soluble in hot and slightly so in cold water, insoluble in alcohol. It is produced by the reaction of hot water on starch. It was discovered and described by TH. DE SAUSSURE. (See *Starch*, and *Fecula.*) I. H.

AMYLUM, AMYLON, AMYLEON or AMYLION. (From α priv. and μυλη, a mill, because formerly made without the assistance of a mill.) Starch. (See this word.) I. H.

AMYRIS. (*Botany.*)

Sex. Syst. Octandria Monogynia.—*Nat. Ord.* Terebintaceæ, Juss.

Gen. Ch. Calyx four-toothed. *Petals* four, oblong. *Stigma* four-cornered. *Berry* drupaceous. WILLD.

The genus Amyris, as understood by LINNÆUS, embraced the genus *Icica* of AUBLET, characterized by having its fruit in the form of a capsule. The two are now considered as distinct by most botanists. A third genus has been formed out of the *Amyris* of LINNÆUS, by KUNTH, with the title of *Balsamodendron*, distinguished by the position of its stamens, which are hypogynous instead of being epigynous. But as the three genera, admitting them to be distinct, are closely allied in botanical character, and are treated of under the same head by the best writers on Materia Medica, it will be most convenient to present, in one view, the few remarks in relation to them which are required by the plan of this work.

1. *A. clemifera*, LINN.—*Icica Icicariba*, DE CANDOLLE.—*Sp. Ch.* "Leaves ternate, also quinate-pinnate, tomentose beneath." WILLD. *Sp. Plant.* This is the plant noticed by MARCGRAVE under the name of Icicariba, which has been adopted by DE CANDOLLE as the title of the species. It is a small tree or shrub, growing in Brazil, and is supposed to be the source of the resinous substance called elemi, brought from South America. (See *Elemi.*)

2. *A. Gileadensis*, LINN.—*Balsamodendron Gileadense*, KUNTH.—*Sp. Ch.* "Leaves ternate entire; peduncles unifloral, lateral." WILLD. *Sp. Plant.*—*A. Opobalsamum*, LINN.—*Sp. Ch.* "Leaves sessile, leaflets pinnate." WILLD. *Sp. Plant.*—In WILLDENOW'S edition of the *Species Plantarum*, the *A. Gileadensis* and *A. Opobalsamum*, are given as distinct species; the former being considered as the source of the *balm of Gilead*, the latter of the *Mecca balsam*. WILLDENOW, however, admits that they may possibly be mere varieties of the same plant, depending upon difference in age or soil. WOODVILLE and other writers of authority are inclined to think them identical. It is certain that balm of Gilead and Mecca balsam are merely different names for the same product, to which other names also have been given, according to the place of its collection or export, as balsam of Judea, of Egypt, of Grand Cairo, of Constantinople, &c. (*Dict. de Mat. Méd.* I. 269.) There can be no great error in ascribing it to one plant, which may properly be called the *balm of Gilead tree.*

This is a shrub or small tree, of a stunted appearance, with numerous spreading, crooked, thornless branches, which, when broken, exhale a strong balsamic odour. The leaves, which consist of one or two pairs of small obovate leaflets, with an odd one at the end, are thinly scattered upon the branches. The flowers are minute, of a white colour, and disposed upon the young shoots, three on a common footstalk, of which only one is productive. The fruit is small, roundish, pointed, of a brown colour, and composed of an exterior covering which opens by four valves, and an interior smooth nut. The plant is a native of Arabia and the opposite coast of Abyssinia. It is said to have been transplanted at a very early period to Gilead in Palestine, from which its highly valued product received the name by which it is most generally known. The Arabs call the tree *balassan*, which is supposed to have been the origin of the terms balsam and balm.

Besides the balsamic juice, which is obtained by exudation or by decoction, (see *Balm of Gilead*,) other products of the plant have been employed. The small branches, broken into fragments, were formerly known in Europe under the name of *Xylobalsamum*, and the fruit under that of *Carpobalsamum*. Both have, in a feeble degree, the agreeable odour and medicinal properties of the juice; but neither is at present used, at least to any c nsiderable

extent. According to Bruce, who has been followed by Woodville and Thomson, the names just mentioned were applied to the balsam itself as obtained from the wood and fruit respectively; but this is contrary to the concurrent statement of other authors whom we have consulted.

3. *A. Myrrha.—Balsamodendron Myrrha*, Nees von Esenbeck.—*Sp. Ch.* "Stem fruticose arborescent; branches squarrose, thorny; leaves ternate; lateral leaflets much smaller than the terminal one; all obovate, obtuse, obtusely denticulate at the end, smooth; fruit acuminate." Nees *von Esenb.*—This is a small branching tree, with a whitish-gray bark, and with its extreme branches rough and terminating in spines. The leaves are small, the terminal leaflet scarcely exceeding half an inch in length. The flowers also are small. The fruit, which stands singly on a short footstalk at the axil of the leaves, is ovate, pointed, brown, and about half an inch long. The tree is a native of Arabia, and probably also of Abyssinia. It was seen upon the borders of Arabia Felix by Dr. Ehrenberg, a German traveller, who collected from the surface of its bark a gum-resin precisely similar to myrrh, of which, therefore, it is supposed to be the source. (See *Myrrh.*) From specimens of the plant taken by Dr. Ehrenberg to Germany, it was referred by Nees of Esenbeck, to the genus *Balsamodendron* of Kunth.

Other species of Amyris, besides those above described, have attracted some attention from medical and pharmaceutical writers, though their products are not recognized as officinal in the Pharmacopœias.—1. The *A. ambrosiaca* of Linnæus, (*Icica Guianensis* and *Icica heptaphylla* of Aublet, *Icica Tacamahaca* of Kunth,) is a tree growing in Guiana and Brazil, and yielding a resinous juice which becomes concrete on exposure, and is used in S. America for the purposes of incense. According to Martius, this resinous product is called *elemi;* but it differs from the substance usually known in commerce by that name. It was formerly imagined that ambergris was the concrete juice of this tree, altered by the action of the water of the ocean, into which it was supposed to have fallen. A variety of the resin called *Tacamahac*, has also been referred to it, though upon insufficient grounds.—2. The *A. Caranna* of Humboldt, (*Icica Caranna,*) grows in Venezuela, and perhaps also in Mexico, and is said to yield a resinous concrete juice called *caranna;* but, according to Bonastre, several different substances are found in the shops under that name. None of them are used in medicine, at least in the United States.—3. The *A. heterophylla*, of Willdenow, (*Icica Aracouchini*, of Aublet,) is a native of Guiana, and the West Indies, and yields a fluid, reddish, transparent, terebinthinate juice, which is collected in small calebashes, where it hardens. It has an odour like that of Peruvian balsam, and was employed by the natives as a vulnerary, and as a perfume.—4. The *A. Kataf* of Forskhal, (*Balsamodendron Kataf*, of Kunth,) is an Arabian tree, which is interesting only as having been supposed by Forskhal to be the source of myrrh, which, however, has subsequently been shown to be the product of a different species.—5. The *A. Zeylanica*, which inhabits the island of Ceylon, is supposed by Geiger, I know not on what authority, to be the origin of the *oriental elemi*, which was used by the ancients as a medicine, though at present scarcely to be found in the drug-shops of Europe or the United States.

Geo. B. Wood.

ANABLEPSIS. (From ανα, again, and βλεπω, I see). Restoration of sight.

I. H.

ANACARDIUM. (*Botany.*)

Sex. Syst. Euneandria Monogynia. *Nat. Ord.* Terebintaceæ, Juss., *Anacardiaceæ*, Lindley.

Gen. Ch. *Calyx*, five-parted. *Petals*, five, reflexed. *Anthers*, nine, with one filament barren. *Nut* reniform, upon a fleshy receptacle. Willd. *Sp. Plant.*

A. occidentale, Linn.—*Cassuvium pomiferum*, Lamarck.—*Cashew-nut tree.* This is the only species of the genus. It is a small tree, fifteen or twenty feet high, with large, oblong-obovate, entire, coriaceous, shining, alternate leaves, and small, red, odorous flowers, disposed in close panicles. It grows in the tropical regions of Asia and America, and is cultivated in some of the West India islands.

A gum exudes spontaneously from the bark, bearing some resemblance to gum Arabic, but consisting partly of gum and partly of bassorin, and therefore not entirely soluble in water. It is the *gomme d'Acajou* of French writers. In this country, it is not used.

The fruit is the part most employed. It consists of a fleshy, pear-shaped receptacle, supporting at its summit a hard, shining, kidney-shaped nut, which has two shells with a black juice between them, and a sweet oily kernel within the interior shell. The receptacle is red or yellow, and of an

agreeable, acidulous, somewhat astringent taste. It is sometimes eaten. Its juice, which is recommended as a remedy in dropsical complaints, is converted by fermentation into a vinous liquor, from which a spirit is obtained by distillation, much used in the preparation of punch, and esteemed diuretic in the West Indies. The nuts are commonly called *cashew nuts*, and were at one time officinal under the title of *anacardia occidentalia.* They were so named from their resemblance to the *anacardia orientalia*, or fruit of the *Semecarpus Anacardium*, produced in the East Indies, and formerly employed as a medicine in Europe. The black juice contained between the outer and inner shell is extremely acrid, and when applied to the skin produces severe inflammation followed by blisters or desquamation. Even the fumes which arise from it when the nuts are roasted, often produce great irritation of the skin; and the worst case of external poisoning which has ever come under our notice originated from this cause. The face was so much swollen that for some time not a feature was distinguishable; but the tumefaction ultimately subsided without leaving any permanent effect behind. The juice is employed, in the West Indies, as a local remedy in warts, corns, ringworms, and obstinate ulcers; and it is said that females sometimes apply it to their face, for the sake of the freshness and delicacy of complexion which follow the desquamation produced by it. The kernel has a sweet agreeable taste, and may be eaten either raw or roasted. It is used as an ingredient in puddings, &c., and as an addition to cocoa in the preparation of chocolate. It becomes rancid by age.

The black juice of the nut, as well as a milky juice which flows from the tree when wounded, is used for marking linen, upon which it leaves an indelible dark stain.

GEO. B. WOOD.

ANACATHARSIS. (From ανα, upwards, and χαθαιρειν, to purge.) Purgation upwards. Hippocrates employed this term to express the expectoration of phlegm or pus from the lungs; but by some subsequent writers its signification was extended to all evacuations by the mouth, thus including vomiting, salivation, and expectoration.

I. H.

ANACATHARTICS. Medicines which produce Anacatharsis.

I. H.

ANAGALLIS. Pimpernel. *Mouron rouge*, Fr.; *Rothes Gauchheil*, Germ.

Sex. Syst. Pentandria Monogynia. *Nat. Ord.* Primulaceæ.

Gen. Ch. *Cal.* 5-cleft. *Cor.* rotate, 5-lobed. *Stam.* filaments hirsute. *Caps.* globose, opening hemispherically, many-seeded. NUTTALL.

Sp. Char. Stem procumbent; leaves ovate, sessile, dotted beneath; segments of the corolla dilated, crenate-glandular. TORREY. This pretty little plant is far from uncommon in most parts of the United States, in cultivated land of a sandy or gravelly nature. It flowers all summer, the corolla, however, only opening in fine weather, and infallibly closing on the approach of rain: hence it has been called the poor man's weather-glass. The Pimpernel, like some other plants, is found in almost every part of the globe, though it is indigenous to Europe alone, but, as is the case with the *Leontodon*, *Cerastium*, &c. soon makes its appearance, wherever colonies of Europeans establish themselves.

The Pimpernel owed its introduction into the Materia Medica, to a belief in its alexipharmic virtues. As early as the time of DIOSCORIDES, it enjoyed a high reputation as an antidote against certain poisons, and especially that of the viper; but its greatest celebrity has arisen from its supposed powers in the cure of hydrophobia. The first author who appears to have recommended it in this disease, was RUFUS, of Ephesus, as early as the year 97: his eulogies of its never-failing efficacy have been substantiated by a multitude of writers of eminence. Notwithstanding this united testimony in its favour, it gradually fell into neglect, until, towards the beginning of the present century, when attention was called to it, from the astonishing cures which were said to have been effected with it in Russia. In this country, also, it has long been celebrated, especially among the Germans of Pennsylvania, one of whom communicated an account of the plant and its virtues to the legislature of that state, in 1802. Among the advocates for its use, was Dr. MUHLENBERG.

Notwithstanding all the testimony in its favour, the Pimpernel has been found as inefficacious in the cure of hydrophobia, as the equally celebrated Scullcap, and affords another instance of a remedy obtaining a high character, when in fact it is wholly destitute of the powers which are attributed to it. At the same time, there can be no doubt, that this plant is possessed of some active qualities. It has a marked acrimony with a slightly bitter taste; and from the experiments of ORFILA, it appears that

it is capable of producing a violent inflammation of the stomach; and M. Angelot, of Grenoble, states that he met with a case where eight ounces of the expressed juice caused a long-continued and violent superpurgation. Besides its anti-hydrophobic virtues, the older writers considered it as a valuable remedy in mania, dropsy, phthisis pulmonalis, &c.; but its real medicinal properties are yet to be discovered, and in all probability a careful examination of them will prove that this plant is wholly unworthy of a place in the Materia Medica.

There are several varieties of this plant; one, which is the most common, having red flowers, and another with blue. These have been thought, by some botanists, to be distinct species; but this opinion is evidently erroneous, as difference of colour alone ought never to be assumed as a specific character: added to which, Ray states that he has met with specimens of the Pimpernel with white flowers.

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R. E. Griffith.

ANAL. (From *anus*, the fundament.) Appertaining to the anus. I. H.

ANALEPSIS. (From ανα, afresh, and λαμβανειν, to take.) This epithet has been employed in several significations: 1st. To denote restoration of strength after disease; convalescence; Galen:—2d. A species of epilepsy arising from disorder of the stomach, and with which the patient is subject to be frequently and suddenly seized; Gilbert:—3d. The support given to a fractured limb; Hippocrates. I. H.

ANALEPTICS. *Analeptica.* A class of remedies suited to restore a loss of the forces of the system, when exhausted by disease or any other cause. This term in its fullest signification would embrace the whole range of stimulants, and is thus used by the earlier writers, whilst at present it is wholly rejected, or restricted to substances of an alimentary nature. As is observed by Cullen, the meaning of this term is so ambiguous, that it should never be employed. In fact, how can we define the limits of this class? as every agent which tends to restore the wasted forces, as repose, sleep, exercise, &c., is, strictly speaking, an analeptic. If, on the other hand, we merely include under this head, those alimentary substances which are of easy digestion and furnish a copious supply of chyle, the objection to this term is by no means removed, as the effects of these do not differ in any respect from food in general. See *Convalescence, Diet, Food.* R. E. Griffith.

ANALYSIS. (From αναλυειν, to resolve.) The resolution of anything, material or intellectual, into its elements.

Analysis in *Physics* and *Chemistry*, denotes decomposition, that is, the separation of what is complex, into its constituent parts. It would be foreign to the objects of this work to enter into the consideration of the means by which this is effected.

Analysis in *Metaphysics*, or the Philosophy of Mind, signifies the process of decompounding our thoughts into their simplest elements, or of resolving our intellectual operations into their primary principles. The analytic method of investigation is at present employed in all the branches of human knowledge, and is that by which the most important results in the sciences have been obtained. Its application to anatomy, gave origin to the doctrine of the tissues, (General anatomy,) and further applied to Physiology and Pathology, it constitutes the basis of Physiological Medicine. (See *Method.*) I. H.

ANAMNESTIC. (From αναμνησις, remembrance.) This term has a double signification. 1st. It is employed to designate medicines supposed to strengthen the memory. It is unnecessary to state that there are none which possess that power.

2d. It is applied to every circumstance anterior to the disease which can elucidate its nature or seat. An antecedent disease, an affection, a passion, any excess whatever, a fall, &c., previous to the attack of the existing disease, are so many anamnestic signs. All morbid predisposing or occasional causes should be arranged among these signs, when they have ceased to exist. I. H.

ANAPHRODISIA. (From α priv. and αφροδιτη, Venus.) Absence of venereal desires. This may depend on functional or moral causes, and may be temporary or permanent; as, however, it is a cause or symptom of *Impotence* or *Sterility*, we refer to those heads. R. E. G.

ANAPHRODITE. (Same derivation.) One who does not experience venereal desires. I. H.

ANAPLEROTIC. (From αναπληροω, I fill up.) An epithet given to medicaments which were supposed to possess the property of promoting the growth or granulation of the flesh in wounds, ulcers, &c. Obsolete. I. H.

ANASARCA. (From ανα, through, and σαρξ, the flesh.) Called also, by the older writers, *leucophlegmatia—pituita alba—veternum hyderos;* and by others, *hydrops externus—hydrops generalis* vel *hydrops cellularis.* That form of dropsy in which the effused fluid is contained in the cellular tissue, particularly that portion of it, which is interposed between the skin and muscles. When the effused fluid is confined to the cellular tissue of a particular part, as of the face or extremities, it is more commonly denominated *œdema;* the term anasarca being applied to the disease when more generally diffused over the surface of the body.

As it is our intention, under the general head of dropsy, to enter very fully into the pathology and treatment of the morbid effusions of a seriform fluid, which occur in the several cavities of the body, we shall confine ourselves, in the present article, to a very brief consideration of those points which have a more strict reference to the form of the disease just indicated.

Anasarca, either by itself, or complicated with dropsy of the abdomen or chest, is a disease of very frequent occurrence, and may affect persons of all ages, of both sexes, and of every rank in life.

It commences, ordinarily, by an œdematous intumescence of the feet and ankles, which at first is chiefly perceptible towards evening, especially when the patient, during the day, has been pretty much in an erect posture; and it disappears during the horizontal posture of the body assumed at night. Frequently, however, the effusion commences in the cellular tissue of the upper extremities, or of the eye-lids and face; and in other cases, it seems to take place at once over the whole surface of the trunk and limbs.

When the first symptom of the effusion is an œdema of the feet, this gradually increases, and becomes permanent; at the same time, the swelling extends, with more or less rapidity, to the legs, thighs, and abdomen, and reaches, finally, the chest, face, and upper extremities—the skin becoming thus, throughout nearly the whole of its extent, more or less distended. The countenance appears bloated; the eye-lids, scrotum, and integuments of the penis, acquire often an enormous bulk, and assume a kind of semi-transparent appearance. The lips lose their vermilion tint, and the colour of the skin is very commonly pale or sallow. When pressure is made with the finger upon the parts occupied by the swelling, a pit or depression is formed, which, in most cases, very slowly disappears. In general, those portions of the body in which the effusion has taken place, have a soft, inelastic, or doughy feel; but as the distension of the cellular membrane augments, the skin becomes more firmly distended, is less compressible, and has a smooth glossy aspect. In some instances, a portion of the fluid becomes effused beneath the cuticle, particularly on the extremities, which it raises in the form of a vesicle. The cuticle, also, in many cases, cracks and gives rise to a constant oozing of an aqueous fluid. In other instances, the skin is said to allow a passage to a similar fluid through its pores, a circumstance, however, which we have ourselves never observed, notwithstanding the very ample opportunities that have been afforded us for studying the disease with considerable minuteness.

Attendant upon anasarca, there is very generally a sense of lassitude or disinclination to exertion; a troubled and wheezing respiration, which increases as the swelling augments. Frequently, there is a cough, and an expectoration of thin mucus. The pulse is very variable, being in some cases full, hard, and active, and in others, small and corded;—in other cases, again, it is slow and oppressed. The state of the pulse, or indeed any of the other general symptoms, it is scarcely possible to indicate with any degree of precision, as they will vary greatly, according to the different causes by which the effusion into the cellular tissue has been produced, and the morbid condition of the internal organs, with which it is accompanied.

The appetite, however, very commonly fails; the skin is often cooler than natural, or even decidedly cold; but in numerous instances, we have, on the other hand, found the heat of the surface to be considerably increased, while, at the same time, the face was flushed, and all the ordinary symptoms of fever were present.

There is almost always more or less thirst, and a diminution in the urinary secretion, which varies in its colour, and other properties. The bowels are commonly costive, and the cutaneous exhalation is either very much diminished, or entirely suspended.

The foregoing constitute those phenom-

ena by which anasarca may be easily recognized, and readily distinguished from every other morbid intumescence affecting the superfices of the body. But in many cases other symptoms are also present, dependent upon the affection of some internal organ, or upon a complication of the anasarcous swelling with serous effusion into the cavity of the abdomen or thorax, or into both. According to Ayre, (*Researches into the Nature and Treatment of Dropsy*,) in the latter cases, the internal dropsy almost invariably precedes that of the cellular tissue.

The progress, duration, and result of anasarca, will depend, very much, upon the cause by which the effusion has been produced, and the nature and extent of the internal lesions which accompany it. Of itself, it is an affection by no means very fatal, and when simple or unaccompanied with serious disease or disorganization of some important viscus, it is not difficult of cure.

The skin becoming moist; the thirst less; and the urine increasing in quantity while the swelling gradually diminishes from the superior portions of the body, are to be considered favourable circumstances. In a few cases the anasarcous swelling ceases by a spontaneous crisis; either by a very copious flow of urine, or watery purging, or a profuse perspiration suddenly occurring.

In some rare instances, the dropsy of the cellular tissue has been observed all at once to disappear, while at the same time extensive serous effusion occurs in the cavities of the head, chest or abdomen, or simultaneously in all of them. This fact was noticed by Portal (*Observations sur l'hydropisie*); and several interesting examples are recorded by Andral (*Clin. Méd.* I. 132.). The external swelling in these cases disappears suddenly, and the patients are immediately seized with great difficulty of breathing, or sink into a state approaching to apoplexy. The impediment to respiration, and the soporose symptoms, rapidly augment, and finally terminate in death. On dissection, the cavities of the brain and of the pleura are found to be distended with serum, while the cellular tissue of the exterior of the body presents scarcely any traces of effusion. (Dance.)

By the autopsical examination of anasarcous subjects, the subcutaneous cellular tissue is discovered to be loaded with a serous fluid, which escapes upon every incision. The more deeply seated cellular tissue is often similarly distended, and in some cases that likewise which is interposed between the fibres of the muscles. When the anasarca has continued for a length of time, the muscles themselves appear soft and pale; the blood is deprived of its plasticity, and of its bright scarlet hue; the heart ordinarily contains a few coagula, soft, and almost colourless. These latter phenomena are, however, almost exclusively confined to those chronic varieties of anasarca which are dependent upon extensive disease of some important organ, or upon long-continued impediments to the free passage of the blood through the veins. In what may be termed the acute forms of anasarca, the solids are less affected; and the blood is less serous, and during life, when drawn from a vein, speedily coagulates and is covered often with a thick buffy coat.

According to Portal, when the anasarcous effusion has been of long standing, the cellular tissue becomes more or less thickened, and its cells augmented greatly in size. Sometimes the skin itself, as well as the adipose and mucous tissues, acquire a great increase of thickness and of density, and are infiltered to a greater or less extent with serum.

Anasarca, as well as all the other forms of dropsy, is, strictly speaking, a mere symptom or effect of various morbid states of the different tissues and organs of the body. It may be dependent, 1st, upon a diminished activity in the forces by which the circulation of the blood is accomplished: 2dly, upon an impediment to the free passage of the blood through the veins: 3dly, upon a diseased condition of the kidneys: and, 4thly, upon a certain grade of inflammation affecting the subcutaneous cellular tissue. To one or other of these causes it is believed that nearly all cases of anasarcous effusion may be referred. In some instances it is probable that several of these causes may coexist, rendering the effusion more extensive, and, at the same time, its treatment peculiarly difficult and unsuccessful.

1. *From diminished activity in the circulation of the blood.* Anasarcous intumescence from this cause, constitutes the simplest variety of dropsical effusion. It is in most instances local, being confined entirely to the lower extremities, and readily disappears as the vigour of the heart, and of the muscular system generally, is restored. This variety of the disease is commonly met with in persons labouring under considerable exhaustion from profuse hemorrhages, excessive discharges from the bowels, fatigue and long fasting, and

during convalescence from long-continued and debilitating diseases. To the same cause is probably to be referred the œdematous swellings so common in persons who remain inactive in an erect position during the greater part of the day, and in those, who, without using a proper amount of muscular exercise, pass their lives in sedentary occupations. According to Rayer (*Sur l'hydropisie*), the effusion in these cases results from the venous circulation of the lower extremities being rendered much slower than natural, in consequence of the inactivity as well as diminished contractility of the muscles of those parts.

2. *From impediments to the free circulation of the blood, particularly obstacles to the return of the blood through the veins.* Anasarca from this cause, is one perhaps of the most common and intractable of the varieties of external dropsy. The impediments to the circulation giving rise to the effusion into the cellular tissue may proceed either from disease of the lungs, liver or other organ; from a contraction of the orifices of the heart and other morbid affections of that organ; from a diseased condition or obliteration of the great venous trunks of the chest, abdomen or limbs, or from pressure upon these vessels, in some part of their course, by tumours in their vicinity. The pressure of the gravid uterus, tight ligatures upon the limbs, and other temporary impediments to the venous circulation, often give rise to an œdematous swelling, which disappears almost immediately upon their removal.

In the variety of anasarca under consideration, the effusion always manifests itself first in, and is frequently confined entirely to, those parts of the body situated above or below the point in reference to the heart at which the impediment to the free passage of the blood exists. Thus, when it is owing to an affection or compression of the veins of the abdomen, it is in the feet and legs that the œdema is first perceived; but if the impediment exists in the veins of the upper portions of the body, the œdema will invariably commence in those parts from which the obstructed veins originate. Genest, in a very interesting paper on anasarca, contained in the *Gazette Méd. de Paris*, for 1833, (I. 569.) maintains that effusion into the cellular membrane accompanying organic lesions which prevent the free circulation of the blood, is in many cases to be considered rather as a concomitant symptom, than as a phenomenon necessarily dependent upon such lesion. Independently of the circumstance of the lesions often occurring without giving rise to any degree of dropsical effusion, he conceives that his position is established by the fact that the anasarcous swelling will frequently disappear, at least for a long time, under the influence of a variety of causes, while the organic lesion remains stationary, or even increases in extent.

3. *From a diseased condition of the kidneys.* Dr. Bright, of London, was the first who pointed out the very common dependence of dropsical effusions upon inflammation and disorganization of the kidneys (*Reports of Med. Cases.* London, 1827.); and his conclusions were subsequently confirmed, to a certain extent, by the observations of Dr. Christison, of Edinburgh (*Ed. Med. and Surg. Journ.* Oct. 1829.), and more recently by Dr. Gregory, of the same city. (*Ed. Med. and Surg. Journ.* Oct. 1831.)

In all these cases the urine was found to contain a considerable amount of albumen, being more or less coagulable by heat; and according to the experiments of Dr. Christison, it is deficient in urea and in its peculiar salts. Although we cannot subscribe to all the conclusions of either Dr. Bright or Dr. Christison, there can be no doubt whatever, in our opinion, that a very large class of anasarcous effusions are attributable mainly to a diseased condition of the renal glands. In this class, according to Genest, are to be included many of those cases of external dropsy ordinarily referred to a commencing organic affection in other organs. The fact is, that irritation and the other morbid states of the kidneys, have been, heretofore, too much overlooked, and hence it is only by their remote effects, and when they have produced such extensive disorganization, as to be, in a great measure, incurable, that they first attract the attention of the practitioner.

In nearly all the cases of anasarca produced by one or other of the causes now enumerated, the intumescence occurs gradually, and is soft, very compressible, and preserves for a considerable time the pits made into it by the finger, or by the pressure of the clothes. It changes readily its place, and the effused fluid has a tendency to accumulate in those parts which are the most depending. The temperature of the skin is in general reduced, and the surface of the body occupied by the swelling has a pale, dull white or sallow hue, and when the distension is very considerable, it is smooth and glossy. The urine is for the most part transparent, colourless, and without any particular sediment.

4. *From inflammation of the subcutaneous cellular tissue.* That anasarca is frequently dependent upon this cause, in the same manner as hydrothorax and ascites are produced by a particular grade of inflammation affecting the serous tissue of the chest and abdomen, we believe with Dr. Ayre, by whom this point has been very fully and ably examined, there cannot be a doubt. It may be said that in the cases of anasarca referred to this cause, the symptoms of inflammation are absent. But we ask, what symptoms of inflammation? We are certainly not to expect those peculiar to the inflammation of other tissues, nor even those phenomena attendant upon the more violent grades of inflammation which affect occasionally the cellular membrane. The fact is, that the symptoms of that grade of irritation which in the serous tissues gives rise to an increased effusion of a seriform fluid, are extremely obscure, and often the first indication we have of its existence is the appearance of an hydropic affection.

The variety of anasarca now under consideration is ordinarily produced by exposure to cold and moisture, by the sudden suppression of some habitual discharge, by various acute affections of the skin, especially scarlatina, and extensive erysipelatous inflammation. According to Dance, it is the present variety of anasarca which frequently occurs in robust females about the period of puberty, when menstruation is retarded or irregular; and at the commencement of pregnancy. It is probably to a similar cause that we are to attribute the extensive œdema by which rheumatic and other inflammations of the joints and extremities are so frequently accompanied, and which we occasionally observe as a symptom of irritable ulcerations of the legs; as well as the general effusion into the cellular tissue produced by the application to the skin of certain vegetable poisons, as the rhus toxicodendron, &c. We have likewise observed this variety of dropsy to occur, in numerous instances, in persons labouring under extensive irritation of the stomach and bowels. It is said also to be very frequently occasioned by imprudently entering upon a too stimulating diet in the early stage of convalescence from acute diseases.

Anasarca from inflammation of the subcutaneous cellular tissue is most generally simple, being very rarely complicated with dropsy of the internal cavities. The intumescence occurs suddenly, and spreads with great rapidity; it is for the most part firm and elastic, and preserves but momentarily the depression made into it by the finger. It is more generally diffused over the surface of the body than in the other varieties; and the effused fluid is less inclined to accumulate in depending parts. The temperature of the skin is often increased, and in place of the dense sallow, or pallid hue observed in anasarca from other causes, there is frequently an increased redness of the surface, with a sensation of heat or formication, with pains of the back, head and extremities, flushing of the face, and occasionally well-marked exacerbations of fever. The pulse is more or less hard, full and frequent, and the urine is occasionally of a deep red colour and sedimentitious.

Treatment. In the first variety of anasarca, little is required excepting to restore strength to the body, and increase the vigour of the circulation, by a light nourishing diet, by frictions of the surface, by exercise in the open air, and a proper regulation of the bowels. The use of the warm bath, and light tonics, may occasionally be found beneficial. As the energy of the muscles increases, and the circulation assumes its normal activity, the effusion disappears entirely. Should, however, the œdema persist, some of the milder diuretics may be exhibited, and repeated according to circumstances.

In the second variety of anasarca, the treatment will vary according to the nature of the organic disease by which the effusion is accompanied. The removal of this, when practicable, is the more important indication, as the effusion will very generally at the same time disappear; or at least may be removed afterwards by very simple remedies. Unfortunately, however, in too many instances the former is beyond the reach of our art; but even in such cases it is always important to attempt the reduction of the anasarcous swelling, as we may in this manner afford very considerable relief to the patient, often protract his existence, and render him comparatively comfortable for a long period.

Bleeding from the arm, adapted in extent to the age, strength, and general condition of the patient, will frequently be found decidedly beneficial. When admissible, the milder hydragogue cathartics, particularly the compound powder of jalap, or a combination of gamboge and cream of tartar, one, two, or three grains of the former, to three or four drachms of the latter, will often reduce very rapidly the swelling; the only cases in which these remedies would appear to be of doubtful propriety, are those in which the patient is labouring under considerable exhaustion,

or in which the stomach and bowels are in a state of decided irritation. From diuretics we have seldom, in this variety of anasarca, derived any very striking results. The squill, digitalis, and calomel, may, however, be tried. The acetate and tartrate of potass have in many cases been found beneficial, and it is probable that in some instances advantage will be derived from the use of the vinum seminis colchici, as well as from the terebinthinates. Alterative doses of mercury have been highly recommended; it is only, however, when they may be presumed useful in removing the organic disease by which the effusion is produced and kept up, that we can expect much good from their administration.

The remedies ordinarily prescribed with a view to the removal of serous effusions will be more fully treated of under the general head of dropsy. Their particular adaptation to the variety under consideration must be left to the judgment of the practitioner; whose decision will have to be influenced, in a great measure, by the peculiar circumstances of each case.

Genest recommends strongly small punctures into the cellular tissue as an effectual means of facilitating the evacuation of the effused fluid. Although we have repeatedly made trial of this means, we must confess that we have seen very little, if any good, result from it.

In the third variety of anasarca, or that dependent upon disease of the kidneys; our treatment must vary according as these organs are simply in a state of inflammation or engorgement, or are already more or less disorganized.

If the disease be recent, the amount of albumen in the urine being but small, and especially if at the same time, a small quantity of blood is occasionally voided with it; if there be experienced a sense of pain or uneasiness in the loins, increased in the act of rising or by the motions of the body, and if the patient be young and plethoric, and his system is still possessed of considerable strength and vigour, bleeding from the arm, repeated according to circumstances, and from the region of the kidneys by means of cups, repeatedly applied; a state of rest; mild demulcent drinks, and a well regulated, but abstemious and unirritating diet, will frequently, in a short time, remove the renal disease, as well as the effusion into the cellular tissue. The patient, however, must be extremely cautious in his subsequent mode of living, to prevent a relapse.

When, however, the morbid phenomena have been of long standing; the urine being loaded with albumen and the patient's strength is exhausted, and his constitution presents a general cachectic condition; there is reason to believe, that the tissue of the kidney is more or less disorganized. We can only hope in such cases to palliate the more urgent symptoms. The repeated application of leeches to the loins may be still required, followed by the formation, at that part, of an issue, or the introduction of a seton; the patient at the same time being put upon a properly regulated diet, and debarred the use of all stimulating food and drinks. The reduction of the anasarcous swelling is to be attempted by mild saline purgatives, as the citrate and supertartrate of potass, and by diuretics, particularly the squill and digitalis, combined with small doses of opium or cicuta.

When the inflammatory affection has been subdued by depletion, Dr. Bright conceives that advantage will in many cases be derived from turpentine and the Peruvian balsam: for ourselves, we should prefer in such cases the copaiba. In one or two instances, where the feeble but extensive beat of the heart led that gentleman to suspect the existence of a soft and flaccid state of the kidneys, a combination of sulphate of quinia and squill removed entirely the dropsical effusion, and effectually restored the patients to health. Uva ursi has likewise been found useful in some of the cases of anasarca attended with diseased kidneys.

Anasarca from sub-acute inflammation of the cellular tissue may in general be very promptly, and permanently removed by bleeding from the arm, governed in its extent and repetition by the symptoms of each case, and the age, strength, and other circumstances of the patient. In a large number of the cases belonging to the present class of dropsies, the prompt and judicious employment of the lancet is all-important. Without the early and often the repeated use of blood-letting, but little hope need be entertained from the beneficial operation of purgatives or diuretics. The detraction of blood is of itself often sufficient to dissipate the anasarcous swelling, or when this is not the case, but little difficulty will be experienced afterwards, in its removal by the milder hydragogue cathartics, or by those remedies which act principally upon the kidneys. In some instances leeches to the anus will be found highly beneficial, especially when the dropsy has succeeded to the sudden suspension of the hœmorrhoidal flux, or when it is suspected to be conjoined with chronic irritation of

the intestinal mucous membrane, (*Ann. de la Méd. Phys.* Aug. 1831.) Dr. Ayre, in cases of œdema, in which the local "serous inflammation" still subsists, directs the application of leeches and cold evaporating washes to the surface; observing not to commence with the latter, until twelve hours after the leeches have been used, to guard against exciting inflammation in the wounds made by them. In cases of anasarca likewise, leeches are recommended by the same author, to the extremities or those parts of the body in which the serous tissue is most affected. We believe this practice to be a judicious one, from which, in numerous instances, the most decided good effects will be derived. In regard to the propriety of the application of at least cool air to the skin in the treatment of the active varieties of anasarca, some useful hints will be found in the writings of Dr. Parry, (London, 1825).

Next to the lancet, the remedies from which the greatest amount of good will be derived, in the variety of anasarca now under consideration, are the milder hydragogue cathartics. There are few cases in which their employment will not be proper; and their use may often be persisted in, until the effused fluids are entirely evacuated, when we are precluded from the employment of almost any other active remedy. The tartrate or super-tartrate of potass, either by itself, or combined with jalap or gamboge, and repeated at such intervals as to produce copious fluid discharges from the bowels, will often, after the employment of blood-letting, in a very short time remove entirely the dropsical swelling. In the active variety of anasarca, we indeed possess few more effectual remedies than the cream of tartar: Dr. Home, of Edinburgh, states that, in his hands, it cured radically fourteen out of twenty of the cases in which it was employed. Dissolved in a large quantity of water, it forms also a very excellent diuretic drink, in the generality of cases.

Various diuretics will likewise be found advantageous in the present variety of anasarca. Nitre and squills, or nitre, gamboge and digitalis; sweet spirits of nitre; the infusion of parsley, and the acetate and citrate of potass, have all been employed by us with good effect, after bleeding. As, however, remedies of this class are very uncertain in their operation—the mildest, in some instances producing a copious increase of the urinary secretion, whilst, in others, the most active are productive of little or no effect—when one fails, another may be tried; taking care, however, always to avoid those possessed of stimulating properties.

The vapour bath is recommended by Genest, in all cases in which there is nothing present to forbid its employment. He conceives that in the reduction of anasarcous swellings it is a remedy of very considerable efficacy, and far preferable to sudorifics, internally. In certain cases, in which the skin appears to enjoy but little activity, it may be proper, he observes, to add to the bath various aromatic substances, or to expose the patient to the fumes of the latter alone. Stork removed in five days, by fumigations of amber, an extensive anasarcous swelling, occurring in a young girl; after various other plans of treatment had been found ineffectual. When the strength of the patient is considerably reduced, while the skin is greatly distended, small punctures into the cellular tissue, to evacuate the fluid, may be tried. Delamotte reports the case of a young man labouring under most extensive cellular dropsy, which was completely cured in three days, by this means alone.

In regard to the diet of the patient, in cases of anasarca, but little need be said. In those attended with a plethoric condition of the body; with an active state of the circulation; with irritation or inflammation of some internal organ, or of the surface of the body, the diet should be very spare, and consist of such articles only as are devoid of any stimulating properties. Thin gruel, toast or barley-water, and the like, in moderate quantities, will be all that is necessary, in a large number of cases, either as food or drink. Even when the strength of the patient is considerably reduced, it will be imprudent to allow anything but the mildest nourishment; and even this should not be taken in too great quantity. It is unnecessary to say anything in relation to the very objectionable practice often pursued by dropsical patients, and even recommended by respectable physicians, of drinking large quantities of gin and water, as a diuretic, and using wine freely, with a view of removing the debility under which they are presumed to labour. In all cases of the disease, this practice will be found decidedly prejudicial, and when the dropsical effusion is connected, as it so frequently is, with chronic irritation of the stomach and bowels, or commencing disorganization of the kidneys, it cannot fail to increase all the more unfavourable symptoms, and hurry on a fatal termination.

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(See Bibliography of *Dropsy.*)

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ANASTOMOSIS. (From ανα, between, and στομα, a mouth.) Communication between two vessels, which do not arise from the same trunk, or at least from the same principal branch, and the purpose of which appears to be, to facilitate the circulation of the fluids. The arteries have fewest of these communications; they occur more frequently between veins; but it is between the lymphatics that there are the most numerous anastomoses. I. H.

ANASTOMOTICS. (Same derivation.) This term has two different significations. 1st. It has been applied to medicines which were supposed to possess the power of opening the mouths of vessels and promoting the circulation, such as Cathartics, Sudorifics, Deobstruants, &c. 2d. In Anatomy, it is used to signify whatever has reference to anastomosis. I. H.

ANATOMY. (From ανα, through, and τεμνειν, to cut.) Literally the act of dissection; but in its ordinary acceptation this term is employed to designate the science of the organization, or of organized bodies. On account of the inadequacy of the term to represent all the objects to which it has been applied, various others, more expressive and appropriate, have been proposed; as *Morphology, Organology, Zoography, Physiography,* &c., which have not, however, been generally adopted, because the term Anatomy has received the sanction of general usage.

The objects of anatomy, considered in its fullest application, are all organized bodies, whatever their characters or importance, in the grand scheme of the universe. But as these objects, examined in the abstract, are diversified, so is anatomy equally varied in its application. Hence it has been divided according to the end it has in view. When applied to the determination of the form, volume, relations, connexions, and structure of the human body, it is denominated *human Anatomy, Anthropotomy, Anthropography,* &c. When directed with the same view, to the investigation of the organization of animals, it is called *Zootomy;* and if the examination of the characters of the vegetable organization be its object, it is designated *Phytotomy.* But however multifarious and diversified may be the beings upon which the anatomist bestows his attention, —whether it be the obscure and simple lichen, the tiny monad or embrion, or man, who is the most complex in his organization and exalted in his attributes, the object is the same,—the mysteries of their organic arrangements, and the determination of their adaptation to the accomplishment of the destinies allotted to them in the great system of nature.

While, however, the form, texture, relations, and connexions of the organization may be said to constitute the principal objects of the pursuits of the anatomist, whatever class of beings may engage his attention; in making a practical application of the principles comprised under these heads, it becomes necessary to subdivide the subject still more minutely, in order to enable him to give a lucid exposition of the details which appertain properly to each. Thus, for example, in the department of human anatomy, the organization may be examined: 1st. In relation to texture alone, without regard to its form, volume, or connexions. This constitutes what has, since the time of Bichat, received the appellation of *General Anatomy,* or Histology. 2. The attention of the anatomist may be directed especially to the determination of the outward form, the volume, weight, situation, connexions and relations of the different parts of the human body, the details appertaining to which, represent what is called *special* or *descriptive*

Anatomy. Both these departments may, moreover, be considered in reference to the healthy and diseased conditions of the organization, and the particular disposition, as regards the form, situation, connexions and relations of the parts comprised within the several regions of the body, examined in reference to their importance in modifying diseases and accidents, influencing surgical operations, and aiding in the formation of a diagnosis. The considerations which appertain to the first head constitute what is denominated *Physiological Anatomy;* those of the second belong to what is called *Pathological, Morbid,* or *Medical Anatomy;* and the third forms a department of the subject to which the appellation of *Topographical Anatomy* has been applied, of which *Surgical Anatomy* is a part.

The range of this department of science, limited, as it is, only by the vast and unknown bounds of animal creation, conducts the contemplation of the anatomist beyond the mere examination of the characters and relations of the human structure. Having determined the properties of the organization of his own species, and taking it as the standard of comparison, he next analyzes the structure of the whole series of animals, from the most complex to the most simple; determines the affinities and dissimilarities of the same or corresponding organs in the various families and species; ascertains what parts are absent, or what superadded; what modifications take place in the different organs, to adapt them to the circumstances under which they are destined to subsist; and thus not only acquires principles by which the whole range of zoological creation can be classed and grouped into families or sections, according to the affinities of their organization, but becomes enabled to penetrate into the still more interesting secrets of animal physiology. These considerations appertain to what is called comparative anatomy, which, when taken in its proper relations, is capable of affording valuable illustrations of the philosophy of organization. There is one ramification of it, especially, which is peculiarly rich in its details, and extensive in its relations. It has received the appellation of *Philosophical,* or *Transcendental Anatomy.* Its object is the more abstract laws of the organization. It does not take particular cognizance of the form, volume, situation or connexions of an organ, but is more particularly interested in determining its existence in the different families and species; in ascertaining its relative importance; in arriving at a knowledge of the manner in which the organization becomes more perfect in ascending, and more simple or imperfect in descending, the zoological scale; and in thus studying its analogies throughout the whole series of beings, establishing its unity, and reducing all its varying characteristics to certain fixed and general laws, the generalities of which are applicable to the entire animal series.

Finally, there is still another species of Anatomy, of more limited application, yet exceedingly interesting in relation to its object. It takes cognizance of merely the exterior conformation of the body; and as it is more especially important to the painter and sculptor, it is denominated *Pictorial,* or *Picturesque Anatomy.* To the same head appertains the consideration of the varying changes which take place upon the superficies, under the operation of its physiological acts, and which hence constitutes what has been called *Anatomy of Expression.*

To make a just appreciation of the subject,—to determine its application, and to estimate its importance, it will be necessary to enter into a brief examination of each of these divisions and to define more particularly its object.

Contemplating it in these relations; as a knowledge of the elements of the organization, and the simple textures formed by them, should properly precede that of the organs themselves, General Anatomy, which has these considerations for its object, naturally presents itself as the first division of the subject.

§ 1. General Anatomy. a. *Objects of General Anatomy.*—The special object of this department of the science is the anatomy of texture, under which is not only comprised a knowledge of the proper elements of the organization, but likewise of the proportions in which they combine to form the various tissues entering into the composition of the several organs and systems. The numerous and apparently dissimilar structures of the animal organization are all composed of similar proximate elements, and are susceptible of being reduced, by an ultimate analysis, to an assemblage of globules intermixed with a simple, homogeneous, coagulable, or coagulated fluid. The province of general anatomy is, therefore, to determine the properties of these proximate elements; to explain the manner in which they combine to form the various fluids and solids of the body; the proportions in which they unite in the constitution of the

combinations; the modifications impressed upon the compounds by the various disposition of their constituent atoms;—to designate, by a rigid analysis, the several fluids and solids which are thus formed; —to ascertain the physical and chemical properties of each; its colour, density, cohesion, elasticity, expansibility, contractility, &c., and the character of its chemical elements;—to investigate their vital properties, and the modifications to which all these, as well as their composition, are subjected by age, sex, temperament, and other causes; and finally, to ascertain the manner in which the more simple structures, endowed with their individual attributes, are united to form others more complex, and these, in their turn, combined to constitute the multifarious organs and systems of the animal economy. In its method, therefore, it must be necessarily both analytic and synthetic. It does not merely take cognizance of the superficies of the several objects which fall within its province. but penetrates in their interior,—separates the various elements, scrutinizes their properties, and then by determining the order of their aggregation, endeavors to unfold all the secret properties of their most intimate texture. Nor should it be restricted to the investigation of the solids, as it has been by some anatomists. The fluids are equally objects calling for the exercise of its resources, inasmuch as they and the solids possess an intimate correlation with each other. (See *Humours.*) The solids form the fluids, and these in their turn are in part converted into solids, and in part pass off from the system in form of extraneous or effete matter. The animal machine is a perpetual laboratory, in which its atoms are submitted to ceaseless change during every moment of existence; and to determine what these changes are, and to appreciate their importance in the grand scheme of living nature, all the elements, both solid and fluid, should be taken into account.

The most simple condition of every animal structure is fluid. The elements of this state of fluidity are, as already represented, an assemblage of microscopic globules disseminated through a homogeneous, coagulable or coagulated fluid. The latter may exist alone, but the globules are never present without the simultaneous existence of the fluid either in its liquid or coagulated state. The consistence of the part will depend much upon the condition of this latter ingredient. When the globules are not present, and the fluid is not coagulated, it will be liquid; and it also retains this character in many parts even where the globules are superadded, as, for example, in many of the animal fluids. On the other hand, the coagulable fluid in a state of coagulation, when united with the globules, always forms a solid of more or less consistence, and which has an appreciable form.

The most simple solid arrangement formed by the combination of these organic elements, is either filamentary or laminated. In giving rise to these two elementary forms, the globules are differently disposed, being in the first arranged in linear series; in the second, apparently disseminated without any very regular order. In both, however, the interstices of the globules are filled up by the coagulable fluid in a state of coagulation. These filaments and laminæ unite with each other in different manners, sometimes giving rise to a species of cellular or areolar arrangement, or the laminæ alone present themselves in form of an attenuated, viscid, concrete, mucous-like substance, divided into numerous portions, which, by having their relations varied, form those cells or areolæ, without the concurrence of the filaments. This is especially manifest in the substance denominated cellular tissue, when it is reduced to its elementary form, and it is probable that the serous membranes merely consist of expanded laminæ of this character, in which, however, according to the observations of Raspail, no globules exist.

By various modifications and states of combination taking place between these two primitive forms of organized solids, a number of proximate arrangements or textures are developed, which we denominate tissues. (See this word.)

The investigation of the properties of these solids and fluids, is the object of general anatomy. But this investigation must not be confined to the surface. The several structures must be unravelled, the various tissues decomposed, their elements isolated, and the order in which they combine with each other determined. The complex organs must be reduced, as far as possible, to their ultimate state of analysis, in order to determine the more secret properties of their texture, and their component tissues scrupulously examined, in order to ascertain their physical and vital properties, and the relations they bear to each other. Having ascertained the composition and vital endowments of the more simple solids, the next object is to determine the manner and the proportions in which they unite, to form those which

are more complex; to inquire into the modifications of structure and vitalism which are produced by these combinations, the changes to which they are submitted by age, sex, temperament, and other conditions—their adaptation to the functions which they are destined to execute, and their relations with each other when blended to form the totality of the organic arrangements. The fluids, likewise, must be submitted to the same rigid investigation. Their mode of formation, as well as their composition, must be as accurately as possible determined; and as some of them, as well as the solids, are endowed with vitality, the qualities which they derive from this endowment should be investigated, as also, the changes and modifications to which they are submitted by age, and other causes which influence them. In these investigations, the unassisted eye alone must not be exclusively relied upon. The adventitious aids furnished by physical and chemical science must be called into requisition, and by the assistance of the various means of mechanical division, the help of the microscope, and the agency of chemical analysis, our researches must be extended even into the intimate molecules of the organic elements, that, by ascertaining their disposition and attributes, we may discover their vital properties, and the part they perform in the general scheme of vital actions.

b. *Appreciation of the value of General Anatomy.* In appreciating the importance of general anatomy, it should be considered in relation to both physiology and pathology, and, through them, to the practical details of the healing art. As regards its relations with physiology, they are so apparent that it is scarcely necessary to discuss the subject. Physiology may be defined the science of living nature. General anatomy determines the properties of the animal organization; analyzes the instruments by the concurrent acts of which vitality is sustained and perpetuated; and, as the phenomena of life are merely the product of an assemblage of functions executed by special instruments, organs, or apparatus, destined for that office, before we can appreciate the character of the acts concerned in the execution of these functions, we must be acquainted with the material arrangement or organized textures by which they are accomplished. General anatomy, by analyzing, as it were, the component parts of organized bodies, teaches that they are composed of an assemblage of tissues, all differing in texture,—all presenting a difference of type,—appropriated to the execution of different functions, and possessing various degrees of vital endowment, but all concurring, by their respective acts, in the production of those phenomena in which life consists. To estimate, therefore, the share performed by each in the accomplishment of these ends,—to determine the acts which are proper to each, and their exact relations with others, requires that the character of the instruments themselves, as regards their intimate texture and vital endowments, should be previously well ascertained. This object accomplished, we proceed in our investigations, from cause to effect,—we advance from data which are fixed and positive, to conclusions which are valid and unvarying, and by thus progressing, from structure to function, we confine ourselves to the rules of inductive philosophy, and deduce no inferences except such as are compatible with the known properties and attributes of the powers which are instrumental in the production of the phenomena of which we take cognizance. Viewed in these relations, general anatomy forms the very foundation of physiology,—constituting the source of all its postulates, and the rallying point of all its conclusions.

To illustrate this proposition, let us take the mucous membranes. We find them spread out upon the whole extent of the internal surfaces of relation, lining most of the hollow organs, and presenting, in different situations, modifications by which they are adapted to the purposes they have to accomplish. They are secernent, exhalent, absorbent, tactile, and besides, endowed with other offices. Thus, in the nares and on the tongue the mucous membrane contributes to form the instruments of special senses, while in other parts, it is mainly concerned in the development of channels of transmission; as, for example, in the larynx and trachea; the mouth, pharynx, and œsophagus; the excretory ducts of the glands; the urethra, &c. In relation to the office of secretion, we find disseminated over its entire surface an infinity of small crypts or follicles, which constantly elaborate a mucous fluid, by which its surface is moistened and protected. To enable it to exhale, it has myriads of vessels terminating in its substance and on its surface, and is besides sufficiently spongy or porous in its arrangement, to admit of the easy transudation or exhalation of attenuated fluids. The same porosity, together with the origin of numerous lymphatics and veins from its substance, explains its absorbent faculty.

It is everywhere tactile, or at least endowed with a species of organic sensibility. These properties it derives from numerous nerves which are distributed to its substance, and which, with the concurrence of minute capillary blood-vessels, form an infinity of delicate papillæ, disseminated over its surface. Where it is appropriated to the purposes of a special sense, as in the nose, and on the tongue, these papillæ are supplied from those nerves which are destined peculiarly for that office. And, finally, where it is merely concerned in the formation of channels of transmission, it is less complexly organized. But where the materials which have to pass over its surface would be liable to offend by their mechanical or chemical properties, we find it protected by a delicate pellicle, denominated epithelium, which being insensible, forms a kind of covering by which it is in a considerable degree defended against injury. This is the case in the mouth, fauces, and œsophagus; the urethra, anus, and vulva. In addition to this, concerned as it is in all the acts of vegetative or nutritive life, and in those which are concerned in the perpetuation of the species, we find it widely diffused,—placed in immediate relationship with the multifarious organs which are subservient to those purposes, consequently linked by a most intimate chain of sympathies with every portion of the animal organism, and forming at the same time, the channel by which all the materials which enter into the economy are introduced, and by which those that escape are expelled. It is the recipient of all impressions, the centre of universal sympathy, and the seat of the most important acts of organic life.

Illustrations equally strong, of the connexion between general anatomy and physiology, are afforded by the examination of almost every part of the organism; and, if further evidence were required to prove the correctness of the proposition which we have laid down, they are furnished by the astonishing advances which physiological science has made since the period at which Bichat first revealed the invaluable principles of general anatomy.

Applying it in the next place to pathology, we shall find its importance not less strikingly exemplified. It reveals to us the seats of diseases, and the causes of their multifarious manifestations: it explains their characters, enables us to form a due estimate of their symptoms, and to trace them to their proper source: it constitutes the only certain guide in our diagnosis and prognosis; and, as diseases consist essentially and totally of some derangement or perversion of the composition and vitalism of one or more of the animal solids or fluids, we can only be prepared by a knowledge of their properties, to appreciate the character and extent of the sufferings which any one may endure, the extent to which it is concerned in the manifestation of the symptoms of the malady, the influence it exercises over other structures with which it is placed in relation, and the consequences likely to result from its implication in the morbid process. There is scarcely a disease, indeed, in which the aids furnished by general anatomy are not necessary to enable us to interpret its characters. Conversant with the texture and vital properties of a mucous or serous membrane, we are prepared to comprehend the phenomena which it presents when affected with disease. However extensive their distribution, and whatever their situation, the maladies which are incidental to them everywhere present something in common, and can be easily discriminated from affections of other tissues. They are, moreover, attended by a different train of phenomena from those which characterize the affections of the organs which they line, or over which they are reflected. Their consequences likewise are very different, and they are often found leading to results which are peculiar to themselves. The same remark may be made of the other tissues. They all possess different degrees of susceptibility, and each one has its own peculiar mode of action. One or more, therefore, may become affected with disease, whilst the others escape or participate in a slight degree; and, as their importance in the living system is different, so are their affections grave or simple, according to the grade of this importance. Hence, we are taught by general anatomy, that diseases are modified by the character of the tissues which they involve: that their seats are to be determined by our knowledge of the structure and vital properties of the several parts of the organization: that where these properties are known, we have only to regard the symptoms as the outward manifestations or the evidences of a morbid condition of one or more parts, and to trace them to their proper origin, in order to enable us to interpret the whole character of a malady, pronounce a just diagnosis, and make a probable prediction of the final result or termination of the disease. The same knowledge will also direct us in the application of our remedies. The whole science of therapeutics must be based upon

an accurate comprehension of the structure and vital properties of the several portions of the animal organism, and of the powers of our remedial agents. The latter produce their effects upon the former, by impressing upon their acts certain modifications; and to understand the application of the one, and the effects which will be produced in the other by its influence, a knowledge of the properties, susceptibilities, and modes of action of the part upon which it is desired to make the impression, is indispensable.

The importance of general anatomy, in relation to pathology and therapeutics, is, moreover, further exemplified by the aid it furnishes in tracing out the manner in which morbific or remedial impressions are radiated throughout the system. As the several tissues possess different susceptibilities, it necessarily follows that no impression made upon any one of them, can be simultaneously diffused throughout the whole system, affecting all its parts at the same time, and in the same degree. Each one, to a certain extent, represents a system distinct and independent as regards some of its acts, yet as respects the assemblage of acts in which life consists, they are all united in one bond of harmony, each one playing its special part in the general scheme of vital actions, but the whole concurring in the consummation of a natural series of results. The nerves will respond more promptly to the impressions made upon them, than the cellular tissue;—the blood-vessels, than the bones; and these latter, than parts which are less exquisitely organized. But while they are all different, as regards their liability to feel the influence of impressions made upon them, the whole are associated in one continuous chain of sympathies, and through this association, influences exercised upon any one of them, will be readily transmited to the others; the order in which this transmission takes place being always, however, determined by the intimacy of the sympathies existing between the respective parts.

The truth of many of these principles was felt and acknowledged long before the time of BICHAT, and even many of the ancient physicians divided diseases according to the textures affected; thus distinguishing inflammation of the pleura, from that of the lungs; affections of the membranes of the brain, from those implicating the substance of that organ. Even extensive applications of those principles which appertain to general anatomy were made to pathology, by JOHN HUNTER, and CARMICHAEL SMITH, both of whom have considered, somewhat elaborately, the modifications presented by the phenomena of inflammation, as it occurs in the various tissues of the body. The importance of thus considering disease, was, at a period somewhat more recent, rendered still more apparent, by PINEL, who, in his *Nosographie Philosophique*, took occasion to class diseases according to the tissues of the body affected; thus furnishing to BICHAT the first hints of an undertaking, the achievement of which has not only immortalized his own name, but created, as it were, a new era in medical science. The principles established by him, and perfected by the labours of his successors, have given a new direction to all our investigations, and, enriched by the new lights furnished by general anatomy, the whole range of physiology, pathology, and therapeutics, has already become fertilized by the addition of new and invaluable principles:—*pathological anatomy* has assumed a more positive and important character, and diseases being correctly interpreted, the application of remedies for their removal is every day more and more directed by fixed and well ascertained principles. What BICHAT did for general anatomy, BROUSSAIS, guided by the same principles, has accomplished for pathology. He has greatly contributed to reduce it to the principles of a positive philosophy, and, although much yet remains to be done; by making a just application of the principles of general anatomy to the elucidation of the characters of disease, he has certainly accomplished a vast deal towards the establishment of medical science upon true and legitimate principles.

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§ 2. *Special Anatomy.* a. *Its Objects and Details.* Special Anatomy, as has been already represented, has for its objects the investigation of the forms and connexions of the organs individually. Far less minute in its details than general anatomy, it merely takes cognizance of the exterior of the several objects which fall within its range, while the latter enters into the intricacies of their inmost texture, seeks to determine their composition, and reveal the properties and arrangement of their ultimate organic elements. Every animal body, we have already seen, is composed of a number of tissues possessing different properties, which, by various combinations, form organized systems destined for the execution of special functions. While, therefore, general anatomy embraces the consideration of these tissues, the province of special anatomy is to examine the form, connexions, and relations of the organs and systems which are formed by them. It is both analytic and synthetic It examines the forms and connexions of each part or organ separately or specially, and then determines the manner in which they are all united or associated in the formation of a general system of living apparatus, by which the assemblage of functions, in which life consists, are accomplished. In these respects, likewise, it is, to a certain extent, physiological; for in the examination of its different objects, it not only takes up the organs individually, but considers them in groups or systems of organs, according as several of them are connected, or concur, in the accomplishment of a special office or function. Thus all the systems are considered in reference to the offices which they execute, all the instruments which are concerned in the performance of a function being examined first individually, then collectively, and finally as associated with others appropriated to some other office. It is, therefore, divided into various parts, according to the parts or systems which it examines. The functions which are concerned in the preservation of animal existence may be all grouped under these heads: 1. Those of relation; 2. Those of nutrition; and 3. Those of generation. The organs by which these functions are performed may be in like manner grouped in accordance with their offices, thus making a direct application of special anatomy to physiology.

In reference to the first set of functions, or those of relation, as motion is an indispensable requisite for their fulfilment, there is an arrangement of parts adapted to this necessity. Under this head, therefore, we have to consider the bones, consisting of a series of solid compact segments, of different volume and configuration, and variously disposed, according to the uses to which they are appropriated. They are all united in such a manner as to form a solid frame work for the other parts of the organization, some of them constituting levers for locomotion, while others are more peculiarly appropriated to the protection of the more delicate and fragile parts. That division of anatomy which treats of these parts is denominated *Osteology.*

But to fit the bones for the performance of their offices, they must be so united with each other as to ensure both freedom of motion and great strength of arrangement. To subserve the first object, their extremities are expanded and covered with cartilage, which is smooth, polished, and elastic. The second is secured by two means; first, by the reception of the prominent portion of the extremity or edge of one bone into a corresponding excavation

of another; and second, by means of numerous strong fibrous bands, or ligaments, by which they are firmly tied together, but in such a manner as not to interfere with their motion. The consideration of these particulars appertains to that department of special anatomy which is designated *Syndesmology.*

These portions of the locomotive apparatus possess no power to move themselves. They are strong and resistant, but altogether passive in the acts which they perform. We accordingly find ingrafted as it were upon every portion of the bony skeleton, an arrangement of incitable, contractile, fibrous instruments, called muscles, which, in acting under the direction of the will, impress upon the solid framework of the system those diversified and complex movements which are concerned in its various acts. The special consideration of the form, attachments, and relations of these instruments, appertains to that part of anatomy which has received the appellation of *Myology.*

These muscles, however, must have something to excite them. Hence we find that they are all supplied with sensitive and inciting instruments, which are composed of the nervous fibre, which regulate their susceptibilities, and maintain their aptitude to contract. These instruments present a peripheral and a central portion, the first consisting of the various nervous trunks and ramifications; the second, of the brain and spinal marrow. The former convey from the latter the influence of the volition to the muscles, by which their acts are called up and regulated, and also transmit to the brain, or centre, those impressions which are made upon their sentient extremities, thus enabling it to take cognizance of their acts, and give them a proper direction. While, therefore, both the peripheral and central portions of the nervous system act conjointly and reciprocally, in exciting and regulating muscular contraction or motion, and in accomplishing the acts of general sensation, the brain alone executes the more noble and important psychological operations of perception, thought, and volition. That department of anatomy which treats of this apparatus is denominated *Neurology.*

But with this endowment alone, the individual would not be able to take cognizance, or judge accurately, of the qualities of all the objects which surround him, to seek whatever is necessary to supply his wants or contribute to his gratifications, or to avoid the multifarious dangers to which he is exposed. Hence his relations with the surrounding world would be incomplete, and he could not provide for his existence. To supply this defect, and to array before his intelligence the whole range of creation, he is supplied with an apparatus of special senses, finely organized and exquisitely endowed. The particular consideration of these instruments appertains to a part of anatomy which may be called *Æsthesiology.*

This is the condition, and these the attributes, of the individual, viewed in his relations with the external world. He has senses to receive the impressions of the multifarious objects which surround him. He has an intelligence to take cognizance of these impressions, appreciate their characters, provide for his wants, and warn him of his perils. He is possessed of instruments of motion to act in obedience to the impulses of his volitions—to transport him from place to place—bear him over the boundless regions of the universe—place within his grasp whatever is craved by his wants or his desires—and to shun the objects of his aversions. Creation is arrayed before him; he acts upon its infinity of objects; appropriates them to his use, or avoids them at his pleasure.

The important apparatus, however, by which these purposes are accomplished, is frail and exceedingly delicate in its characters, and subject to ceaseless changes during every period of its existence. The materials of which it is composed merely perform their office for a limited period, and then pass away to give place to others. Hence the necessity of an apparatus by which a perpetual supply of organic elements may be furnished, to preserve the organization against destruction,—by which the individual may be enabled to derive from the medium in which he lives, those materials which are proper to nourish and sustain him, and impress upon them such changes or modifications as to adapt them to the exigencies of his nature. We accordingly find him endowed with organs of prehension, regulated in their acts by the senses of which we have already spoken;—instruments for the trituration or mechanical division of his food,—others for its transport through the body, and for the separation of its nutritive from its excrementitious portions. This apparatus, complex in its conformation, delicate in its organization, and extensive in its relations, consists essentially of an elongated and tortuous tube, upon which are engrafted a number of glands, which pour their diversified secretions into it, there to perform an important part in the acts which it has

to execute. By a series of changes effected in the food by the concurrent agency of different portions of this apparatus, aided by a play of chemical affinities—it is broken down or decomposed, its nutritive parts are subjected to new combinations, and are separated from the excrementitious portions, to be circulated by myriads of streamlets throughout the intricate textures of the organs—while the latter are thrown off as effete matter.

Superadded, therefore, to this apparatus, there are an infinity of attenuated vessels, which pump up, by their numerous radicles, the nutriment elaborated and separated by the other organs, and transmit its materials through their channels into the proper circulation—where, mingling with the blood, and undergoing still further changes, they become a portion of that fluid, and, indeed, constitute its proper elements. It is through these channels that the whole materials of the organization are introduced; the individual thus appropriating to his use those substances which a bountiful Providence has spread before him, and deriving from them materials to nourish and sustain his frail and perishable organs.

To insure the full consummation of these objects, however, the materials thus derived and prepared must be conveyed throughout every part of his system, in order to be brought in relation with the structures which they are destined to build up and preserve. We accordingly find, that the blood which is directly concerned in its accomplishment, moves in a perpetual circle. It is sent out by arteries and returned by veins, between which the heart is interposed, as an agent of impulse, to force it through the meandering course of the numerous vessels which it has to traverse. Besides this greater circle, it is, moreover, made to move round a lesser circle through the lungs, there to be brought in relation with the atmosphere, in order to part with some of its materials, and at the same time to acquire others by which it is better fitted for the purposes of life.

Finally, to these parts are added numerous glands and instruments of exhalation, by which the waste of the organization is either separated and thrown off, or a secrementitious fluid is formed from the blood, to be returned to it again, and become subservient a second time to the purposes of nutrition. Some of these secernent glands have appended to them receptacles, or reservoirs, for the retention of their fluids until a convenient time may arrive for their final expulsion, or until they are demanded for the fulfilment of the offices which they are destined to accomplish.

Such is the diversified and complicated apparatus concerned in the important functions of nutritive or vegetative life. Though different portions of it are appropriated to the execution of dissimilar acts, they all concur in the accomplishment of one final purpose. The alimentary canal receives and transmits the food, and with the glands which are engrafted upon it, prepare the chyle, and separate it from the innutrient portions of the food. The lacteals absorb it, and convey it into the blood with which it is conveyed to the heart. This organ, endowed with a strong muscular arrangement, distributes this latter fluid, on the one hand, to the lungs, through the pulmonary artery, whence, after having undergone important changes, it is returned through the pulmonary veins; and on the other, through the aorta, to every part of the organization, whence it is conveyed back to the heart, by corresponding veins. The glands secrete from it a diversity of fluids, and by the process of exhalation a considerable quantity of its thinner parts are constantly draining away. Thus, while digestion repairs the perpetual waste of the animal structures, the refuse and worn-out materials are constantly passing away through the instruments of excretion and exhalation.

That part of anatomy which treats of the organs of digestion and depuration is denominated *Splanchnology*, under which head is also included the organs subservient to the propagation of the species; while the consideration of the instruments of circulation, including the heart, arteries, veins, and lymphatics, appertains to the department called *Angeiology*.

The third class of functions includes those which are necessary for the perpetuation of the species. The instruments which are concerned in them differ in the two sexes, but in each may be divided into those for the preparation or vivification of the new being, and those of copulation. The consideration of these in like manner is generally ranged under the head of *Splanchnology*.

There is, besides, a department of special anatomy which has for its object the history of the development or the evolution of the Fœtus and its appendages. This is denominated *Ovology*, or *Embryology*.

b. *Appreciation of the importance of Special Anatomy.* After the observations

which have been already made, but little need be said in reference to the value of special anatomy. If less important in its application to physiology and pathology than general anatomy, it is nevertheless indispensable to enable us to comprehend the arrangement and connexions of the apparatus concerned in the execution of the various vital functions. In order to comprehend and appreciate any set of phenomena, we must first be acquainted with the instruments which are efficient in their production; and as each function of the animal organization has a special apparatus by which it is executed, it would be as impossible to understand its phenomena, without a previous acquaintance with parts employed in their manifestation, as it would be for the mechanist to comprehend the various revolutions of a piece of complex machinery, without being conversant with the arrangement of its wheels and levers. While the more minute characters of structure which are revealed by general anatomy can alone serve to explain the more delicate and obscure acts which are directly concerned in the execution of a vital function, its generalities, and the manner in which it is associated with other functions, cannot be fully comprehended without that knowledge which is imparted by special anatomy. Thus, general anatomy teaches that the brain is composed of white fibres and a gray pulpy substance, and that various parts of these structures are endowed with different vital attributes; but it does not show that the convolutions are the seat of a multiplicity of faculties, each one having its special locality. It points out the properties of all the tunics and humours of the eye, but leaves us in ignorance of the manner in which these parts are disposed to constitute one of the most beautiful and perfect specimens of an optic instrument, capable of refracting the rays of light, bringing them to a focus upon the retina, and thus placing the individual in direct relation with all the wonders and beauties of creation. It reveals to us the structure of bone, of muscle, of mucous and serous membrane, of glands, &c., yet we are not taught by it how a bone is adapted, by its shape and its arrangement, to resist the influence of violence, or to move in accordance with that mechanism which it is its office to subserve;—how the direction and attachment of a muscle suit it for the accomplishment of a given purpose;—how the arrangement of a mucous membrane into a convoluted tube, adapts it to the execution of the complex acts of digestion, or how one portion of this tube is merely appropriated to the purpose of transmission, while other portions perform the more important part of decomposing the food, and separating its nutritive from its excrementitious portions. It is true, that special anatomy, taken alone, and considered in the abstract, is of comparatively little value, but when viewed in connexion with the anatomy of structure, its importance becomes manifest, and the necessity of an acquaintance with its details is rendered indisputable.

Its utility in reference to pathology is also incontestible. As the morbid states of the organization involve the colour, configuration, and relations of its different parts, as well as their texture, in order to be able to appreciate the character of its lesions, it is as necessary we should be able to designate what changes these properties undergo, as to determine the alterations which occur in their intimate texture. This will be impossible, without an accurate acquaintance with the form, volume, colour, situation and connexions of the several organs in their healthy state, which can alone prepare us to determine the modifications impressed upon them by disease.

Nor is its importance confined to the mere discrimination of lesions; it is equally great in reference to diagnosis. To detect the existence of disease in particular organs, their situation and relations must be clearly understood; otherwise, when several organs are grouped together in the same region, the symptoms which are proper to one, might be referred to another, having no participation in the morbid condition. Thus, in exploring the right hypochondriac region in an individual affected with pain, the character, situation, and relations of all the organs contained within it should be remembered, because the pain or suffering may proceed from an affection of any one of them. Thus, it may be seated in the liver, gall-bladder, biliary ducts, pylorus, duodenum, kidney, the attachments of the diaphragm, &c. The intimate connexion which exists between the duodenum and the liver, through the medium of the gall-ducts, the nerves, veins, &c. likewise elucidates the manner in which they may become associated in diseased action, and the order in which their sympathies are reciprocally transmitted, and thereby enables us to appreciate the value of any train of symptoms which they may present, and to refer them to their proper sources.

With a view to its practical application,

special anatomy may be investigated by two different methods of procedure. According to the first, which is most commonly pursued, each apparatus, or system of organs, is considered separately and without a direct reference to those with which it is associated; as, for example, under the heads of *Osteology*, *Syndesmology*, *Myology*, *Splanchnology*, *Angiology*, *Neurology*, &c. Under the second, more fruitful in its practical illustrations, the whole body is mapped off into regions, which are defined by natural or imaginary lines or boundaries, and all the parts entering into each are investigated, layer by layer, from the circumference towards the centre; the characters of each being scrupulously examined, their connexions and relations accurately determined, and the influence they are capable of exercising upon diseases and operations carefully estimated. The first, which we have already considered, is *Special Anatomy* properly so called:—the second is denominated *Topographical*, *Regional*, or *Surgical Anatomy.*

§ 3. *Topographical* and *Surgical Anatomy*;—more properly denominated *Medico-Chirurgical Anatomy.* As in the investigation of special anatomy according to the ordinary method, the principal object is an application of its details to physiology, an order for the most part physiological is pursued; so, in the examination of the subject topographically, as our end is its application to medical and surgical pathology, we disregard, for the most part, those considerations which are purely physiological, to determine the importance of the several structures considered in reference to diseases, accidents, and surgical operations. To attain the objects we propose, our investigations must here take a different direction. We are still interested in the configuration, size, situation, relations and connexions of the different parts; but instead of examining each separately and independently, we always have a special reference to its relations and connexions with other parts, and its individual and aggregate importance in the region in which it is found. An accurate anatomical chart of the superficies of the body is the first object of our investigations. We define all its prominences and depressions,—we subdivide it into regions or sections, by ideal or natural lines, and then taking each of these regions separately, we determine accurately the disposition and relations of its different parts, progressing from the periphery towards the centre, in order that by ascertaining all their mutual bearings, we may be enabled to pronounce upon the probable injury sustained by any one or more of them, by an instrument traversing them in any direction; the manner in which they may be affected by diseases involving their structures; their importance in displacements; and the influence they are capable of exercising under all these circumstances. In mapping out these regions, we are not governed by any natural limits presented by the organs themselves, or determined by their uses. We are merely governed by the importance of the parts, and their concurrence, as manifested in reference to any one or more pathological conditions. The number of regions, therefore, may be very differently estimated, and their extent varied according to the object proposed. Thus, we may make a single region of the whole head, or it may be subdivided into parts of more limited extent, in order to constitute separate divisions of its *frontal*, *parietal*, and *occipital* portions. The same course may be adopted with the face, the neck, thorax, abdomen, &c. It will be best, however, as a general rule, merely to comprise, as far as possible, within each region, such parts only as possess a similarity of character, or concur in the accomplishment of the same set of acts; thus avoiding, on the one hand, the unnecessary multiplication of regions, and on the other, the equally bad course of making them too extensive. Nature has, indeed, to a certain extent, laid the foundation for such a division. In a longitudinal direction, the trunk is divided by the linea alba into two lateral and symmetrical portions. In the opposite direction, it is likewise divided into several sections, consisting of the head, face, neck, thorax, abdomen, pelvis, and extremities, all of which present clear and well defined limits. These, however, though useful to a considerable extent, cannot be rigidly adhered to without further divisions, in the investigation of those details which appertain to topographical anatomy. Hence, some of them must not only be subdivided into anterior, posterior, and lateral, but likewise into transverse sections of variable dimensions and configuration.

In pursuance of this course, we shall divide the whole superficies of the body into the following regions:

I.	The Head - - - - - -	*a* Cranial region.
II.	The Face - - - - - - -	*a* Facial region.
III.	The Neck - - - - - -	*a* Anterior Cervical region.
		b Lateral Cervical region.
		c Posterior Cervical region.
IV.	The Thorax - - - - -	*a* Thoracico-axillary region.
		b Sternal region.
		c Costal region.
		d Scapular region.
V.	Abdomen - - - - - - -	*a* Epigastric region.
		b Umbilical region.
		c Hypogastric region.
		d Hypochondriac region.
		e Lumbar region.
		f Iliaco-inguinal region.
VI.	Perineum - - - - - - -	*a* Ano-perineal region.
VII.	Spine - - - - - - - - -	*a* Vertebral region.
VIII.	Upper Extremities. - -	*a* Brachial region.
		b Region of the bend of the arm.
		c Antibrachial region.
		d Carpo-metacarpal region.
IX.	Lower Extremities - -	*a* Glutæal region.
		b Crural region.
		c Popliteo-sural region.
		d Sural region.
		e Tarso-metatarsal region.

It will be unnecessary, at present, to define particularly the limits of these regions. Those which are of the most practical importance will be described under their appropriate heads, when their boundaries and relations will be specified. Those which appertain to the abdominal portion of the trunk have been already considered, and we may refer to the article *Abdomen* for an exposition of the method to be pursued in the investigation of those details which belong to topographical anatomy, and in their practical application.

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Monographs upon particular parts of the body will be included under the bibliography of the regions of which they treat.

§ 4. *Pathological, Morbid,* or *Medico-chirurgical Anatomy.* Pathological Anatomy is the philosophy of the organization in its various departures from the healthy or normal state. Like healthy or physiological anatomy, it takes cognizance of both solids and fluids, and in its present

improved and extended condition, does not, as formerly, merely confine itself to a sterile description of changes of form and texture, but investigates the modifications of the vital acts by which they are produced, the laws which are concerned in their development, the influence exercised by them upon the health of the individual, and their ultimate tendencies under the various influences to which they may be exposed, either therapeutical or hygienic. It is thus made to constitute the very foundation of physiological pathology, which may be regarded as the proper source of all medical principles, and a guide to all our therapeutic indications. Viewed under these relations, it constitutes one of the most valuable resources in determining the characters of disease, unravelling its intricate philosophy, and in directing the judgment of the physician in a rational application of remedies for its removal. It becomes the starting point for all his investigations, a rallying point for his conclusions, and a stern ordeal by which their validity must be tested and their relative value duly estimated.

These remarks, however, only apply to pathological anatomy as a science, as it has been built and coordinated in modern times, and not to that vague and formless detail of miraculous cases,—of assembled wonders, which our ancestors were so busily engaged in treasuring up;—to pathology, as founded upon laborious clinical observations, and a rigid investigation of the changes impressed upon the solid and fluid elements of the organization by the multifarious maladies to which they are liable,—and not to that form of it which solely consists in a recital of cases, or a description of lesions,—which is merely founded upon statical phenomena, or the alterations of the form, texture, composition, colour, and relations of the organization, without any reference to those which are dynamical, or the modification of the vital forces by which these lesions are produced, or which are developed by them after they have become established. The first is pathological anatomy in its infancy, —as cultivated by Bartholin, Schenkius, Blasius, Bonetus, Tulpius, Morgagni, Hoffman, Sandifort, and most of those of former times:—the second is that pathological anatomy which may be regarded as the natural offspring of the rich discoveries of Bichat,—which may be said to have had its foundation laid by him, while its superstructure has been raised, coordinated, and embellished, by the joint labours of Dupuytren, Bayle, Laennec, Meckel, Broussais, Cruveilhier, Andral, and a long list of indefatigable investigators, whose names have honoured the age in which they live, and whose exertions have revolutionized the science of medicine, and done much to reduce it to the principles of a positive philosophy. While the works of our ancestors may be regarded as a vast store-house, rich in isolated facts, the materials collected by them are disposed without order, and form a heterogeneous assemblage, the value of which is in a great degree lost, in consequence of not being systematized into a body of principles, founded upon the characters of the lesions themselves, their mutual or reciprocal affinities, and the modifications of the dynamical laws, or vital properties of the organization, which were either instrumental in their production, or which might be occasioned by them when once developed. Like the materials of a building, or the wheels of a clock, each piece or parcel possesses an intrinsic value; but by lying disjointed and in disorder, this value cannot be correctly appreciated, because they are not grouped and harmonized so as to show their proper relations and dependences,—to display their symmetry, manifest their power when acting in concert, or the manner in which they are capable of being influenced by other powers acting upon them when united in one common bond, and constituting one harmonious whole. It is only when thus united that they display their intrinsic value, and manifest the extent and importance of their application in the establishment of principles, and in the interpretation of the intricate phenomena of disease. In modern times, much has been done to collect together and adjust these heterogeneous materials; they have been disposed into something like order and system, and, still further multiplied and enriched by the fruits of subsequent investigations, they have been worked into an edifice, regular in all its parts, firm in its relations, and rich in its benefits. While, therefore, under the progressive improvements developed by time, pathological anatomy has acquired a new aspect,—it has likewise arrived at a degree of perfection which admits of its being applied to the explanation of many phenomena of which it did not formerly take cognizance; and a mass of invaluable principles have been established by it, which, but for its lights and resources, could never have been revealed. Under the former direction given to its studies, it was supposed that the subjects which fall within its range, as

they were the anomalies or aberrations of nature, could not be referred to any fixed and determinate laws; but now that its resources have been more perfectly unfolded,—that its application has been more fully made, and its various ramifications have been more thoroughly scrutinized in all their bearings, it furnishes the important confirmation of the immutability of the laws of nature, and that whether we contemplate them in the harmony and regularity of those works, which, from their constancy, we regard normal, or in the apparently irregular and perverted direction of them which is concerned in the development of what we call the anomalies of nature, or the anomalies of the organization, we find that everything is still under the government of fixed and determinate laws,—that there is under no circumstances a violation of the constant and eternal principles of nature, and that even those unseemly and revolting productions of our being, which, from the hideousness of their forms, have received the appellation of monstrosities, are governed in their evolutions by principles as fixed and unvarying as those which preside over the development of the normal type of the organization.

But, to realize all the benefits that pathological anatomy thus perfected is capable of conferring, and to render it capable of a still more extensive and fruitful application, it will be proper in its investigation that the true principles upon which it is founded should be constantly kept in view. These principles, it has been already remarked, must be deduced from the consideration of both the static or organic, and the dynamic or vital phenomena. Pathological anatomy, to display all its riches, must march hand in hand with physiological pathology. They are mutually dependent,—they reciprocally illustrate each other, and they cannot, in accordance with the principles of strict philosophy, be separated. It is only by viewing them conjointly, and by blending their lights, that the mysterious phenomena of disease can be unravelled, and that the pathologist and practitioner can discover a clue to conduct him to the ultimate object of his investigations.

To render this truth more apparent, let us for a moment see what is the course pursued by the mere anatomist, and the mere pathologist, in the investigation of disease. The one directs his attention to the organic lesion. He examines the organization in reference to its alteration of form, size, position, colour, texture, and composition, and erects these into postulates from which he deduces all his conclusions, regardless of the causes by which these changes have been produced, and with only a hypothetical conjecture in relation to their consequences. He does not analyze the symptoms in reference to the lesion, and cannot determine how far the one is dependent on the other, or their degree of relationship of cause and effect. His whole attention is absorbed with the consideration of the condition of the diseased organ; and, intent upon that, he neglects the dynamic phenomena concerned in its development, as well as those which are brought into existence under its influence. The pathologist reverses the order of the investigation. He only regards the symptoms or accidents manifested in the course of the disease, and from such data attempts to arrive at a knowledge of the organic lesion, or modifications of the organization by which the symptoms are produced. He erects the effects into postulates, and from them vainly endeavours, by travelling backwards, to obtain a knowledge of causes. Either course cannot well fail to lead to erroneous conclusions, because, whichever is adopted, hypothesis is unavoidable. The ultimate result of such investigations must consist of an assemblage of facts and of gratuitous assumptions, and as there are no means of determining what is true and what is false, the value of the facts is merged in the hypothesis. Suppose that truth is to be found in a line,—the anatomist sets out at the central point, where he discovers facts, but only advancing in his investigations towards the terminal extremity of the line, leaving the other unexplored, all beyond the centre is mere conjecture. The pathologist, on the other hand, setting out at this extremity, also finds facts at that point; but, as his investigations advance backwards, and are merely based upon arguments *à posteriori*, his facts are of little value, and are so intermixed with error as to deprive them for the most part of any practical application of which they might otherwise be susceptible.

To give to pathological anatomy its just value, the investigation of its topics must take a wider range and be somewhat differently directed. As it is proper that they should embrace both the static or organic phenomena, and the dynamic or vital, they should determine by a strict analysis; 1. the changes which have taken place in the texture and other properties of the affected organ: 2. the functions or physiological action of the organ should

be interrogated, with the view of ascertaining by what mechanism, or by what modification of these acts, the organic lesion has been produced; and 3. the vital phenomena, or the symptoms of the disease, should be submitted to a rigid scrutiny, in order that by considering them in reference to the diseased alteration of the organ, the precise relationship and dependence which exists between them may be accurately determined. LOBSTEIN. *Journal Complimentaire*, III. 20. Paris, 1818.

It is only when investigated according to these rules that pathological anatomy is entitled to be considered as a science, and is capable of becoming a rich and exhaustless source of principles, elucidating the characters of disease, forming the groundwork of a correct diagnosis and a successful therapeutics, and at the same time fertilizing the whole range of medical and surgical science. The same extensive scope of investigation, moreover, is indispensable to lead to a sufficient acquaintance with the various alterations in the form, composition, and relations of the organization, and with the diversified modifications which are developed in its various liquid and gaseous products, to enable us to estimate their collective and individual importance, to determine their correlationship with each other—how far they are dependent in the relationship of cause and effect—and to establish such a coordination of all the facts and principles of the science as to admit of their being grouped according to their natural affinities, and thus arranged into a system harmonizing in all its parts.

To investigate the details of pathological anatomy in this spirit, a mere examination of the external form and colour of an organ, or of its volume, situation, relations, &c. will not furnish those data upon which the postulates of the science can be safely founded. These characters may be sufficient to demonstrate the existence of disease, but they will lend only feeble aid in determining its character, or the kind and degree of participation the vital powers may have had in its production. Neither can they furnish sufficient grounds for a rational explanation of the disturbance which may be awakened in the system, or a probable estimate of the consequences which may ensue. In order to obtain this information, the pathological anatomist must extend his observations beyond the surface:—he must penetrate into the interior of the organs, and submitting them to the rigid scrutiny of analysis, he must unravel their intricate composition, separate and scrutinize each of their elements, determine the kind and degree of alteration any one or all of them may have undergone, what modifications have taken place in their properties and composition, how far their materials have become altered, and what new products have been deposited in the midst of them, or usurped their place. Should the ordinary mechanical means of analysis not be adequate to lead to satisfactory conclusions, he must invoke the aids furnished by chemical science, and by ascertaining the difference between the proximate elements of the diseased organ and those which appertain to it in a state of health, determine the changes which have taken place in its composition or texture. In his estimate, he should take into account all the characters of the organ,—its form, situation, volume, weight, colour, density, cohesiveness, elasticity, expansibility,—if complex, the relative proportion of its constituent tissues, the quantity of fluids it may contain and their character, and even its chemical composition. He should especially isolate his investigation of the membranous envelop of an organ from that of its parenchymatous structure, and determine, as far as possible, whether the lesion has been developed primarily in those tissues which are general, and which constitute a part of every organ, or in those which are special to the organ itself. Having furnished himself with the data to be derived from these sources, his next object is to ascertain what modifications of the dynamic or vital phenomena have been concerned in the development of the mischief, and from the kind and degree of the mischief itself, what relationship it has had with the accidents or symptoms manifested during the life of the patient,—how far it can be regarded as the cause of death, and the probable manner in which it has led to that result.

As every tissue composing the complicate organization has properties of structure and vital endowments which are peculiar to itself, so is there a corresponding difference in its liability to disease, and peculiarities equally palpable in the character of its morbid affections. Hence, in those tissues which are general, or which are everywhere distributed, the participation they have in the disease can often be recognized, not only in those portions of them which are free, but even in those which enter into the minute arrangement of the organs. This is especially true of the cellular and vascular tissues, and will likewise apply even to the serous and mu-

cous, though they are limited in their distribution. Thus, the former of these tissues is remarkably liable, under a perverted direction of its nutritive acts, to a species of induration, which frequently takes place in its free or external investing portion, but which can likewise be, in many instances, recognized in the midst of the organs, implicating the interstitial portion which constitutes the proper connecting medium between all its elements. It may, indeed, become thus affected without the other elements of the organ undergoing much change; or if they do experience any alteration, it may arise merely from the encroachment of the diseased cellular tissue upon them, to such an extent as to promote their absorption, and supply their place. This is manifested in the indurated condition of the liver and other glands which has been denominated scirrhosis; in the thickened and indurated condition of the œsophagus, stomach, intestines, &c. which has frequently been described under the name of scirrhus; in what is called the cellular transformation of various organs; and in the condition which has been sometimes denominated lardaceous degeneration. Under all these conditions, the other component parts of an organ are frequently found but little affected, or they are merely encroached upon mechanically in the manner already explained; hence, when such a condition is observed, the evidence is conclusive that the disease has not implicated the whole substance of the organ, but has for the most part confined its ravages to this single element.

Evidence of a similar character is frequently furnished by the faculty of secretion, or rather exhalation, possessed by this tissue. Thus, if an individual should fall a victim to a disease of the lungs, and on inspection the cellular tissue of those organs should be found infiltrated with a serous or a sero-sanguineous fluid, the other structures being but slightly or not at all affected, it would be fair to conclude that that element had constituted the proper seat of the disease.

A similar remark may be made of many other tissues. The coats of the blood-vessels, it is well known, are remarkably prone to take on a species of calcareous degeneration; and this is not confined to their trunks, but often takes place in those minute branches which ramify through the substance of the organs. Hence, in apoplexy, it frequently happens, that while the tunics of the blood-vessels are diseased, no alteration of structure exists in the corresponding portion of the brain, and the injury which is eventually sustained results entirely from a rupture of the vessels, and a consequent extravasation of blood. In the spleen, in the substance of the uterus, about the vagina, and in the vicinity of the neck of the bladder, small calcareous degenerations are frequently found, which are developed at the expense of the blood-vessels, while the other structures exhibit no appreciable alteration.

Illustrations of a similar kind might be multiplied to a great extent, all showing the importance of not confining attention to the structure of the organ in the aggregate, or in the totality of its elements, and the necessity of cautiously isolating those elements,—of decomposing the organ, as it were, by our analysis, and nicely investigating every piece or tissue of which it is constituted. In the hollow organs which are composed of several tunics, nothing is more common than to find one of these tunics extensively altered—even disorganized, while the others are nearly healthy; and in the liver, which is composed of dark and light-coloured granules intimately incorporated with each other, or, as it is sometimes expressed, of cortical and medullary substances, the one is frequently found extensively altered, while the other may present little or no departure from its healthy condition. The same remarks will apply to all the investing membranes,—the periosteum, the synovial membranes, the dura and pia mater, the tunica arachnoidea, the pleura, pericardium, peritoneum, tunica vaginalis, &c. —all of which are often the seat of important lesions of structure, without the organs which they cover presenting any very important alteration, or exhibiting any very palpable disturbance of function.

There are other considerations which render it important to investigate the lesions of the several organic forms in their isolated state. Such investigations are not only valuable in their application to pathology, but constitute an important resource for general anatomy and physiology. It is sometimes difficult, from mere inspection, or from our ordinary means of investigation, to determine with absolute certainty the properties of a tissue, or even the presence of one, where it is so delicate in its arrangement as to escape observation. The fact, however, that such a tissue presents abnormal states identical with those which are proper to some other, the characters of which are known, justifies the conclusion that they are similar, or belong to the same class. There are several parts of the animal economy in

which this principle is very forcibly illustrated. By some it has been affirmed that the uterus is not lined by a mucous membrane, because in the natural state of that organ such a structure cannot be so satisfactorily demonstrated as in some of the other hollow organs. The diseased states of the organ, however, prove incontestably the existence of a mucous membrane continuous with that which lines the vagina, and presenting the same properties. Like other mucous tissues, that which lines the uterus is subject to an active hemorrhagic process, to a redundant secretion of mucous or a muco-purulent fluid, constituting a kind of uterine catarrh, and to the development of polypus and other morbid growths, which are peculiar to mucous membranes. Facts of an analogous character prove the identity, or at least a striking similarity, between the dermoid and mucous tissues. When the skin is covered with an exanthematous eruption, the mucous membranes are frequently affected in the same manner: when the mucous membranes of the digestive canal are the seat of a protracted irritation, it is not unusual for the follicles of the skin to take on diseased action; and when their respective relationship becomes so far changed, as that one shall be placed in that situation which is proper to the other, a corresponding transfer of character takes place in the tissue. Thus, when the mucous membrane of the rectum, of the vagina, or uterus, is exposed for some time to the drying influence of the atmosphere, as in the prolapsus or inversion of those organs, it becomes covered by a kind of epidermis, and assumes the character of the skin; and, vice versa,—when the skin is so situated as to be excluded from this drying influence, as, for example, where two surfaces are kept for some time in apposition with each other, exemplifications of which are sometimes presented in the folds of the groins and knees of young children, in the doubling inwards of the lips of a wound, and in the space between the nates of corpulent individuals, it secretes a muco-purulent fluid, and acquires the characters of a proper mucous surface. The skin, it is well known, is subject to a species of horny or verucose transformation:—the same morbid condition is frequently developed in some parts of the mucous membranes, especially about the glans penis, the orifice of the vagina, and the verge of the anus. The existence of muscular fibres in the gall-bladder has been generally denied by anatomists, because they cannot be demonstrated in the healthy state of that organ. When, however, its several tunics have become considerably hypertrophied, under the modifications of nutrition which are developed by a protracted irritation, these fibres often become so apparent as to render it easy to trace out their distribution, not only upon the vesicle itself, but likewise upon the common duct. In the moveable articulations, moreover, it has been affirmed by some that the synovial membrane terminates abruptly at the margin of the articular cartilage, and is not distributed over its surface; but the morbid changes which this surface undergoes, prove satisfactorily that the membrane is continued over the entire free surface of the cartilage. The same remark may be made in relation to the continuation of the tunica conjunctiva over the surface of the transparent cornea of the eye. It cannot be easily or very satisfactorily shown by dissection or maceration; but by the abnormal changes to which it is liable, the fact is very clearly demonstrated.

Pathological anatomy has tended greatly to correct many physiological errors, and to enrich that science with new facts and principles. In no part has it furnished more important aid than in the physiology of the nervous system. It was long since remarked, that a lesion of the hypoglossal nerve merely occasioned a paralysis of the tongue, without affecting the sense of taste; thus establishing an important truth which has been since fully confirmed,—that there are separate nerves for sensation and motion, and that while the hypoglossal is subservient to the latter office, as regards the tongue, the former is executed by a branch of the fifth pair. It has also been remarked that a disease or injury of the portio dura occasions a paralysis of the face, while its sensibility remains unimpaired; and, on the other hand, that a similar condition of the branches of the fifth pair, which are distributed to that region, annihilates sensation, without affecting motion. To those who have questioned whether the olfactory nerve is the proper instrument of smell, pathological anatomy has furnished a satisfactory refutation, by demonstrating that a lesion of that nerve has been attended with a complete destruction of the faculty of smell. It likewise furnishes some of the most fruitful illustrations of the physiology of the brain, and has already presented a multiplicity of facts, which have established beyond all possibility of contradiction, that the mind is composed of a plurality of faculties, all having separate locations in that organ.

This is exemplified by what takes place in mechanical injuries, in apoplexy, organic degenerations, changes of structure, &c. implicating different parts of that portion of the nervous centre, which are always found to be attended with an impairment or complete annihilation of the psycological faculty which is located in the part of the organ affected, while the other faculties frequently retain their perfect integrity. Facts of the same kind have shown, that particular portions of the brain preside over different acts concerned in the performance of other functions; one portion being concerned in vision, one in regulating progression backwards, another forward progression,—one directing the voluntary movements of the upper, and another those of the lower extremities, &c. Pathological anatomy likewise shows the order in which the different parts of the organization are evolved, as well as the relative importance of the several portions of it, at certain periods of life. A careful study of the characters of monstrosities has demonstrated, contrary to the belief formerly entertained, that instead of the heart being the *primum vivens*, or the brain and the spinal marrow being indispensable conditions of life, many other organs take precedence of them in development; that the fœtus may pass through its entire period of intra-uterine life, and even move actively, without any vestige of either brain or spinal marrow. The lights revealed by it have also completely set aside many hypotheses formerly entertained in relation to the nourishment of the fœtus from the liquor amnii, by furnishing cases in which there was no point at which that fluid could possibly find an entrance into the alimentary tube. It should be remarked, moreover, that there are many parts of the organization the functions of which cannot be satisfactorily determined by a mere observance of their physiological manifestations; but if they be rigidly investigated through the manifestations which they present in disease, when their acts become more conspicuous,—if they be carefully scrutinized by the combined lights of pathological anatomy and clinical observation, a clue will often be furnished by which their offices may be determined.

Much discrepancy has existed in the method or order of investigating pathological anatomy, and disposing its multifarious details. The fathers of the science, if they may be thus styled, content with a mere detail of isolated facts or lesions, without entering upon any generalizations upon the mode of their production, their characters or affinities, confined themselves strictly to the anatomical order, merely detailing the various organic changes which take place in any organ in connexion with the organ itself. This course was pursued by BARTHOLIN, BONETUS, MORGAGNI, LUDWIG, CONRADI, SANDIFORT, LIEUTAUD, BAILLIE, VOIGTEL, and all the early writers on the subject. The new direction given to anatomical investigations by the creation of general anatomy by BICHAT, suggested the practicability of coordinating the details of pathological anatomy in such a manner as to group the organic lesions in accordance with their characters and affinities, as this physiologist had disposed the healthy structures. Actuated by these views, BICHAT, himself, proposed to make general anatomy the basis of a classification of organic lesions; and, since his time, several works have been written adopting this arrangement, and in accordance with these principles. It is impossible, however, to comprehend within such a classification, a number of important subjects which properly belong to pathological anatomy. It could only be made to embrace the lesions of texture and of the fluids, and would necessarily exclude all the important deviations of form, whether congenital or accidental, as well as all the heteroclite developments which take place in different parts of the organization. To be convinced of the defects of such a method, it will only be necessary to refer to the work of CRAIGIE, perhaps the most complete which has yet been formed upon the principles of general anatomy. Although it contains a valuable exposition of the pathological anatomy of the tissues, it merely embraces a fractional part of the multifarious details which belong to that science, and excludes an immense range of topics of a highly important character.

To obviate these defects, DUPUYTREN and LAENNEC, about the same time, proposed a classification founded upon different views. According to the arrangement of the former, as it is given with slight modifications by CRUVEILHIER, all lesions are distributed into four classes. The first comprises every lesion of a mechanical character, and all vices of conformation. The second comprehends those lesions which consist in an alteration of texture, with which are included transformations, organic productions, and degenerations. A third class comprises those organic lesions which arise either from irritation, atony, or the extinction of the life of a part of

the organization. Under the fourth, are ranged those lesions which are denominated vital, and of which pathological anatomy cannot take cognizance,—as fevers and the neuroses.

In the classification of LAENNEC, the various subjects are also distributed into four classes. 1. Modifications of nutrition. 2. Modifications of form and situation. 3. Modifications of texture produced by external agents, or the development of new tissues. 4. Entozoa, or the development of living animals within the system.

According to this arrangement, the third division embraces the alterations of texture proper, whether they be produced by mechanical violence, by the accumulation or extravasation of those fluids which naturally exist in the system, by inflammation and its consequences, or the development of a tissue or product which does not exist in the body in a state of health. These last are divided into those which are analogous to some of the natural tissues, and those which have no normal prototype in the organization.

Both these classifications, though they form, as it were, the first step towards a systematic coordination of the materials of the science of pathological anatomy, are defective in important particulars. There is no just foundation for the distinction between the first and the third classes of LAENNEC, since inflammation and its consequences, and the various heteroclite and homöoclite developments which are ranged under it, are as much results of modifications of nutrition, as hypertrophy and atrophy, which are placed in the first class. Nor is the scheme complete, inasmuch as it excludes the whole of the monstrosities, and the various congenital vices of conformation. The division which it makes, however, of the accidental developments, into those which resemble some one of the natural tissues, and those which are foreign in their characters to the whole of them, is well founded, and has been adopted by all subsequent pathologists.

MECKEL has constructed a much more philosophical arrangement. He makes two great classes, founded upon the alterations of form and those of texture. The first, he subdivides into congenital and acquired or accidental alterations of form. The second class, or the alterations of texture and composition, includes, 1. those states which are produced by physical causes; 2. all new organized products, as the regeneration of tissues, those formations which are analogous to the natural structures, and the heteroclite developments; and, 3. those products which have no natural connexion with the organization, as, the entozoa, calcareous concretions, &c.

So far as the pathological anatomy of the solids is concerned, this arrangement is perhaps liable to as few objections as any one that could be offered, and it presents this important advantage,—that it naturally assimilates itself with physiology, and thus leads directly to the consideration of the laws of organogenisis, or the modifications of the vital acts which are instrumental in the development of the various abnormal conditions which it embraces. This, we have already remarked, is the true spirit in which pathological anatomy should be investigated, and the only one by which a proper substratum for physiological pathology, the only true foundation of medical science, can be laid. Still, this classification is altogether defective in one particular. Under the division of deviations of form, it provides amply for monstrosities and all the accidental vices of conformation to which the organization is liable; but it excludes the fluids, which cannot be with propriety omitted. A modification of the same arrangement has been adopted by OTTO, who, however, has made no provision for the defect just noticed.

ANDRAL and LOBSTEIN, the most recent writers on the subject, have adopted an order founded for the most part upon physiological principles, and which is not liable to the objections we have urged against that of MECKEL.

The former groups the whole of the conditions of which pathological anatomy takes cognizance, under the five following heads: 1. Lesions of circulation. 2. Lesions of nutrition. 3. Lesions of secretion. 4. Lesions of the blood; and, 5. Lesions of innervation.

The first division of LOBSTEIN's arrangement comprises the lesions of nutrition; the second, the modifications of the situation and connexions of the organs; the third includes the rarefactions of the tissues produced by *pneumatosis*, *hydranosis*, *hematonosis*, *fluxion*, and *inflammation;* the fourth, those accidental developments which are analogous to the healthy tissues; the fifth, the heteroclite developments or degenerations; and the sixth, those morbid products which have no organic connexion with the natural tissues.

The classification of ANDRAL, it will be seen, makes no provision for those abnor

mal states which consist in solutions of continuity from external violence, or in displacements of the organs; and to get clear of the vices of conformation and monstrosities, he is compelled to refer them to a lesion of nutrition, consisting in an alteration of the natural arrangement of the molecules. The heteroclite developments are also separated from the lesions of nutrition, to be placed amongst those of secretion. There are also some objections which might be urged against the arrangement adopted by LOBSTEIN. Both these classifications, however, furnish advantages which cannot be obtained by any of those previously suggested, since they coordinate the static and dynamic phenomena; and in thus pursuing a physiological course, while they take cognizance of the various changes developed in the solids and fluids, they explain the modifications of the vital acts by which they are induced.

Adopting these principles, we would propose an arrangement somewhat different. While we agree that the primary division of lesions of form, and lesions of texture and composition, adopted by MECKEL, is well founded, we are sensible that it cannot be carried out in its details, without separating lesions which belong to the same class, and placing others where they do not belong. We shall, therefore, merely use these characters as distinctions under the several classes, dividing those of form into congenital and acquired, as has been done by MECKEL. There are three distinctive characters which must be applied to all lesions when considered in every relation. These are, 1. quantity; 2. quality; and, 3. situation. Were it not that we are obliged to embrace in our scheme the dynamic as well as the static or organic phenomena, these might be erected into classes; but as these characters are produced even in the same organ by different causes, some of which are physical and some vital, we shall use them as mere subdivisions of a scheme founded for the most part upon physiological principles.

Applying this method to both solids and fluids, the whole of the lesions may be arranged as follows:

SECTION I. Lesions of Circulation.

- Quantity
  - Augmentation of the quantity of the blood .... Hyperemia.
  - Diminution of quantity .... Anemia.
- Quality
  - Plastic powers of the blood increased .... Hypertrophemia.
  - Plastic powers diminished .... Phthieremia.
- Situation
  - Issuing from the vessels and escaping externally ... Hemorrhage.
  - Escaping from the vessels into the substance of a tissue, or into a cavity .... Extravasation.

SECTION II. Lesions of Innervation.

- Quantity
  - Innervation exalted .... Hyperesthesis.
  - Innervation diminished .... Anesthesis.

SECTION III. Lesions of Nutrition.

- Quantity
  - Congenital
    - Defective or interrupted: vices of conformation, and monstrosities from defect.
    - Preternaturally active: vices of conformation, and monsters from excess.
  - Acquired
    - Increased .. Hypertrophy.
    - Diminished: Atrophy. Ulceration.
- Situation ... Misplaced ... Transformations of tissue, or homöoclite formations.
- Quality
  - Cohesiveness of the nutritive molecules increased ... Induration.
  - ——— diminished .. Softening.
  - Nutritive molecules heterogeneous
    - Heteroclite tissues
      - Tubercle.
      - Melanoma.
      - Tyroma.
      - Cephaloma
        - Scirrho-Cephaloma.
        - Collo-Cephaloma.
        - Hemia-Cephaloma.
        - Cephaloma.

SECTION IV. Lesions of Secretion.

- Quantity
  - Secretion augmented: Extravasation. Flux.
  - Secretion diminished.
- Quality
  - Modification of the natural secretions.
  - New secretions
    - Organizable.
    - Not Organizable ....
      - Pneumatoma.
      - Hydronoma.
      - Pyonoma.
      - Colloma.
      - Steoma.
      - Alsoma.
      - Lithoma.
      - Melanoma.
      - Kirronoma.
      - Ephaloma.
      - Chloasoma.
- Situation
  - Formed in unusual situations.
  - Transported to unusual situations.

SECTION V. Physical Lesions.
- Physical Lesions of texture.—Wounds.
- Physical Lesions of situation
  - Displacements
    - Dislocations.
    - Hernia.
    - Prolapsus.
    - Retroversion, antiversion, invagination, inversion, inflexion, &c.
  - Accidental distortions, &c.

SECTION VI. Living products having no natural connexion with the organization.
- Entozoa.

This classification will embrace all the lesions of the organization considered in a general manner, or viewed in their totality and as liable to affect any of its parts. But, as all, or at least most of them, may implicate every part of the system, it becomes necessary, in carrying out the details, in order to avoid endless repetitions, to consider the characters of each lesion, in the abstract, before it is described in its special relations with the organs which it may implicate. Hence, we divide pathological, like physiological anatomy, into general and special; the first having for its object the consideration of the general characters of the elementary or primordial pathological states, in the abstract, and independent of the parts which they may affect; the second, the special consideration of these pathological states, as they are manifested in the various tissues and organs. Thus, after having determined the characters of each lesion, in advance, we are prepared to appreciate the phenomena and modifications which it presents in the several tissues and organs.

Under the head of special pathological anatomy, we first examine the various lesions as they occur in the widely diffused tissues; as, the cellular, osseous, cartilaginous, fibrous, muscular, vascular, nervous, &c., and, afterwards, as they are manifested in the several systems or apparatus of organs, in the order of the functions which they execute. This course should not be pursued in relation to the perfect organization only, but also extended to the products of conception, and the evolution of the fœtus.

Estimate of the value of Pathological Anatomy. Some of the aids which pathological anatomy is capable of affording to healthy anatomy and physiology, have already been alluded to. We have now to speak of its importance in relation to medical and surgical pathology, and therapeutics.

It may be regarded as the only certain foundation of a correct diagnosis. To be convinced of this fact, it is only necessary to recur to the histories of disease given before pathological anatomy fertilized the science, and to compare them with those furnished by the best writers within the last twenty years, since the study of organic medicine has been made to constitute the principal source of all pathological conclusions. Then, all was obscurity and conjecture;—now, much that could not formerly be explained, or which constituted a train of merely idle speculation, is rendered clear and intelligible. The seats of diseases not being known, their symptoms were comparatively of little value, because they could not be correctly interpreted; and it was impossible to determine the proper character of the morbid affection, since no conception could be formed of the manner in which it affected the organization,—what tissue or organ was its seat,—what changes it induced in the texture and vitalism of the part, and the manner in which those symptoms were developed which constitute its outward manifestations. Not to go back to that period when catarrh was absurdly supposed to be a fluxion from the brain, rheumatism an acrid humour falling upon the muscles and joints, and phlegmasia dolens a transfer of the milk from the mammæ to the lower extremity, let us take some of the best works of even very modern times, and we shall see how defective was the science of diagnosis, for the want of a knowledge of organic lesions, and how erroneous were the ideas entertained of the seat and characters of an infinity of diseases, which, owing to the assistance afforded by pathological anatomy, are now well understood and successfully treated. Thus, by way of illustration, we may take what CULLEN gives as the pathology of dysentery. He attributes all the phenomena of that disease to a state of constriction of the colon, which divides it more exactly into cells, giving occasion to the formation of hardened

feces. With this constriction, there is some effort at a peristaltic motion, which, however, only increases the spasm, and renders it more painful. This more violent spasmodic affection extending to the rectum, may emulge its mucous glands, and *squeeze out blood from the superficial blood-vessels*, which is to explain the whole phenomena of the disease.

Let any one who is the least sceptical, compare this pathology of dysentery with that which pathological anatomy has established, and if this does not convince him of the advantages to be derived from the study of organic lesions, let him take two cases of the disease as nearly alike as possible, and treat the one upon those principles suggested by the pathology of Cullen; the other, upon those dictated by the knowledge that dysentery is a violent inflammation of the mucous membrane of the colon, exciting spasm of its muscular coat; and we think conviction cannot fail to follow. Let him take the whole range of the cachexies of the same author, and compare the explanations offered of their characters, with the clear and philosophical views of the same affections given by Broussais, in the "*Phlegmasies Chroniques*;" or by any respectable modern writer who has stored his mind with the treasures of pathological anatomy, and he will find light where all was before darkness,—truth where before everything was shrouded in error,—and cannot fail to perceive the immense advantages which have resulted from the study of organic lesions in connexion with clinical observation.

In investigating any disease, there are two problems to be solved: 1. the organ affected, and the kind and degree of its implication: 2. the modifications of the vital acts in which the morbid affection consists. These points are indispensable to enable us to form a correct diagnosis or prognosis, and are alone sufficient to found a correct and rational therapeutic indication. The phenomena of the dynamic or vital modifications, consist, moreover, in every case, of two series: 1. those which precede the development of the morbid state of the organ, and which constitute what is called the prodromus of the disease, or the *proëgoumenic* symptoms: 2. those supervening upon the change which takes place in the organ, and hence denominated *epigenetic* phenomena.

Taking these principles as the basis of pathological anatomy, and the rules by which it is to be applied to the science of diagnosis, it will be seen, that there are but few morbid affections in which it will not afford important illustrations. In a large proportion of diseases, a knowledge of organic lesions is indispensable to enable us to determine their characters; and there are exceedingly few, except some of the neuroses, in which it will not assist in arriving at correct conclusions.

What, for example, was known of puerperal fever, until dissections revealed that most of its phenomena are referrible to an inflammation of the serous membrane of the abdomen? and what knowledge had we of croup, until we were taught by autopsic examinations that it consists in an inflammation of the lining membrane of the air passages, giving rise to the development of an adventitious plastic membrane, adhering to the internal surface of the tube, and impeding respiration? To pathological anatomy, we are likewise indebted for nearly all we know of the whole range of the phlegmasiæ. It reveals the difference between an inflammation affecting the membranous envelopes of an organ and its proper structures; it explains the successive changes which the structures undergo; the order in which they succeed each other; how far they may advance without destroying life; and the steps by which the parts return to their healthy condition. It demonstrates that an inflammation of the membranes of the brain is characterized by a different train of symptoms from those which attend an inflammation of the texture of that organ; that an affection of this kind, merely attended with a slight effusion of serosity, will often occasion convulsions, and that a considerable quantity of fluid poured out by the same process, will sometimes produce paralysis. What should we know of apoplexy, or of the symptoms which arise from softening of the brain, if dissections did not explain to us, that in the one there is extravasation of blood, either within the substance or on the surface of the organ, embarrassing or annihilating its functions; and in the other, that there is a pulpy disorganization, disqualifying the organ for its office, or perverting its acts? It has also taught us, that many cases of epilepsy are owing to tumours or spiculæ of bone pressing upon the brain, or to lesions developed within the substance of that organ; that cataract consists in an opacity of the crystalline lens, interrupting the transit of the rays of light; that gutta serena is often dependent upon some organic modification of the retina; that deafness may proceed from a closure of the eustachian tube, or a change of structure in the auditory nerve; that a lesion

of the olfactory nerve destroys the sense of smell; that when the third branch of the fifth pair is injured, taste is affected; and that there will be paralysis of sensation or motion, according as the posterior or anterior parts of the spinal chord, or the portions of the brain with which they are associated, are affected.

In the diseases of the chest and abdomen, pathological anatomy has not been less fertile in its illustrations. Pleurisy and pneumonia were confounded, until dissections taught that they were essentially distinct; and the pathology of hydrothorax was not understood, until autopsic examinations proved that it was owing to an effusion of serum and plastic lymph, resulting either from inflammation of the serous tissues of the thorax, or from an obstacle to the passage of the blood through the cavities of the heart. Nor did we know anything of the characters of those formations by which the surfaces of the organs are agglutinated, or their areolar texture consolidated, until pathological anatomy demonstrated that they are produced by a deposit of a plastic fluid, in which vessels are formed, and which thus becomes organized. How endless and visionary were the speculations offered in relation to the causes of the palpitations of the heart, of asthma, of angina pectoris, of cyanosis, and many other diseases of the chest, until autopsic investigations traced nearly all these affections satisfactorily to various lesions of the heart and adjacent organs! Consumption was formerly attributed to inflammation of the lungs, terminating in abscess; and chronic catarrh, or bronchitis, was confounded with it, under the name of catarrhal phthisis. Pathological anatomy, in demonstrating that consumption is always owing to tuberculous degeneration of the lungs, and the subsequent disorganization of the new product, has shown the error of the former opinions entertained of its character, and that it is essentially different from both pneumonia and catarrh.

It has also explained many of the causes of jaundice, by demonstrating that any obstruction to the passage of the bile from the liver, will lead to its absorption and subsequent diffusion with the blood, and incorporation with the solids of the body. It has, likewise, explained the causes of dyspepsia, cholera, ileus, diarrhœa, dysentery, and tabes mesenterica. It has shown that the primordial condition of all these diseases is an irritation of the mucous membrane of the stomach, giving rise to various changes of structure, and exciting various sympathetic phenomena. It has proved, that in the latter affection, the enlarged and degenerated state of the mesenteric glands has its origin in an irritation commencing in the mucous tissue, and radiating along the course of the lymphatic or chylous vessels to the glands. We are in like manner indebted to it for an illustration of the important truth, that in many of the diseases which have been mentioned, there is frequently very extensive carcinomatous degeneration of the coats of the stomach,—ulceration, softening, thickening and induration of the mucous membrane,—contraction of the diameter of the intestine, and even perforation of its walls. In like manner, we have been taught by it, that a large proportion of those anomalous and distressing symptoms which were formerly grouped under the heads of nervous and cachectic diseases,—which were considered states of pure debility, and treated as such,—derive their origin from a sub-inflammation of the mucous membrane of the first passages, propagating its influence through the ganglionic nerves to the cerebro-spinal centres, to be thence reflected upon the different organs.

The whole range of diseases which affect the liver, spleen, kidneys, ovaria, uterus, and the genital organs generally, have also been equally illustrated by pathological anatomy; and it has likewise contributed much to elucidate the pathology of the fluids which are poured out by those that secrete. We are in like manner indebted to similar investigations for our knowledge of extra-uterine fœtation, rupture of the uterus, displacements of that organ, as well as the various accidental developments which take place in its substance and in its appendages.

In no respect, perhaps, have the advantages of pathological anatomy been more strikingly displayed than in the determination of the characters of the various organic transformations and heteroclite developments. Of the true nature of tubercle, of the diversified conditions denominated scirrhus and cancer,—pancreatic sarcoma, medullary sarcoma, encephaloid degeneration, fungus hematodes, &c., we possessed no definite information, until they were explained by the labours of modern pathological anatomists. It is true, that the lights thus acquired, have not contributed much to improve our success in the treatment of these formidable degenerations; yet it is important to be acquainted with their characters, that we may be able to distinguish them from those

which are curable,—that we may form an accurate prognosis of the probable issue, and that we may know how far we can rely upon the resources of the art, as well as the extent to which our interference can be safely carried.

Nor are these all the advantages which have been derived from the cultivation of pathological anatomy. It has completely reformed the doctrines of the essential or idiopathic fevers. They are no longer regarded as diseases involving the whole organization equally, and independent of any local affection. Whatever may be the mode of their origin, or the vital modifications concerned in their development, reiterated autopsic investigations, aided by careful clinical observation, have shown, that they are always accompanied with some local organic affection. Instead, therefore, of referring them to spasm and atony,—to bile and other vitiated humours,—to a deterioration of the blood,—or to morbific matter pervading every portion of the organization, and contaminating every element, we know that the phenomena of the disease are always associated with a lesion of some organ. Our object, then, is to determine the seat and character of this lesion, the modifications of the vital acts which have been instrumental in producing it, and the disturbance or consequences to which it gives origin. We thus become possessed of the essence of the malady;—we are enabled to make a correct interpretation of all its phenomena,—trace them to their proper sources, form an accurate estimate of their collective and individual importance, and thus acquire positive data upon which to predicate all our therapeutic indications.

Pathological anatomy cannot reveal to us the hidden essence of the exanthematous diseases; neither can its resources reach the mysterious character of the venereal or hydrophobic virus, or the element of the scrofulous diathesis. Still, it can array before us the horrid effects of all these instruments of human destruction, by unravelling the formidable ravages which they commit upon the living structures, and, in this way, not only explain how death is induced, but, in like manner, furnish suggestions calculated to lead to a rational and successful treatment. The whole range of cutaneous diseases has, moreover, been greatly illustrated through its agency. It has satisfactorily demonstrated that a great proportion of the varying modifications of these affections are merely owing to the different parts of the dermoid structures that may be implicated, and that instead of considering every shade of form or physical aspect which an eruption may present, as constituting so many diseases differing in their element, many of them are referrible to one and the same condition, and should be treated upon the same principles.

Aided by the collateral lights of chemical science, it has done much to elucidate the obscure and difficult pathology of the fluids. Upon this point, however, our knowledge is, unfortunately, as yet exceedingly limited. Yet an impulse has been recently given to these investigations, which cannot fail to lead to important results. But, in calculous disorders, its utility has been strikingly manifested. A careful study of these productions has led to the discovery of the condition of the system by which many of them are produced, and in thus revealing their proper causes, has laid the foundation for a successful method of preventing their formation.

Pathological anatomy is in like manner identified with every part of surgical pathology. It lends its aid in explaining the complex phenomena induced by inflammation,—how the tissues become softened or indurated by that process; how they are disorganized; the characters of the new products which are formed; the properties of pus; how it becomes circumscribed in the substance of a tissue or organ, or travels through its parenchyma to some remote point; how it progresses to the surface to be discharged; and, finally, the process by which the ravages inflicted on the organization, either by vital or physical agencies, are repaired. To pathological anatomy is the surgeon also indebted for a knowledge of the characters of tumours and other morbid products requiring his interference;—for an explanation of the nature of hemorrhage, and the modes by which his means prove effectual in arresting it; and for the process by which wounds and ulcers are healed,—fractured bones consolidated, and mutilated parts restored. Without its illustrations, what could he know of aneurism and the principles upon which its treatment should be conducted? How could he venture to obliterate the main trunk of an artery, if he was not aware, that through the anastomosing vessels, a sufficient collateral circulation can be carried on to maintain the vitality of the limb? Or how could he explain the process by which a ligature applied to a vessel is capable of effecting a permanent obliteration of its calibre, without endangering the life of the indi-

vidual by hemorrhage? It explains the characters of hernia, the changes which take place in the protruded parts, and the consequences inflicted upon the strictured organ; it has laid the foundation for a rational and successful method of treating artificial anus; and has illustrated the characters of hemorrhoids, of fistulæ, and of prolapsus ani, and suggested appropriate treatment. The diseases of the bones and articulations have been rendered clear and intelligible by its illustrations; as have also the various displacements and distortions to which they are liable. In short, to represent its importance to the surgeon, would be to detail every disease and accident which falls within the province of his art.

The department of obstetrics is not less indebted to pathological anatomy. The distortions of the pelvis; the displacements of the uterus; the diseases to which it and the other female organs are liable; the anomalies in the development of the products of conception, and the accidents to which they are subject, all derive important illustrations from it; and he alone who is thoroughly enlightened by its principles, can be competent to meet successfully the emergencies of the parturient state, and surmount the numerous obstacles which impede delivery.

Need we insist upon its importance to the medical jurist? There are many questions connected with this important department of the science, which derive their whole illustrations from pathological anatomy. The physician is often called upon to give evidence in relation to the causes of death. It is indispensably necessary, therefore, that he should be enabled to discriminate between those lesions which are the natural result of disease, and those which are produced by poisons, or other agents, administered for criminal or unlawful purposes. In questions of rape and incompetency; of infanticide; of death from violence; and under a variety of other circumstances, his opinions must be formed from that knowledge which is derived from the same fertile source; and upon no other data, unaided by pathological anatomy, can he place any positive reliance. Ignorance upon these points, has sent thousands of victims to the scaffold, for crimes which were never committed.

Pathological anatomy furnishes the only data which can be safely relied upon in the classification of diseases. All attempts to arrange them according to their remote causes or their symptoms, are vain and nugatory. Of the former, we know comparatively nothing; and the latter are so variable, and uncertain, that any scheme of nosology founded upon them, could only lead to inextricable confusion. The remote causes of disease, are, many of them, amongst the *res recondita*, and no human intelligence can ever scan them. We know not whence they come, or what are their attributes; but we know their effects,—we can take cognizance of the ravages inflicted by them upon the organization;—the lesions they develop; and by determining the character of these lesions, and the symptoms to which they give rise, we have a full-length picture of the malady placed before us. Inasmuch, therefore, as the mischief inflicted upon the organization, and the disturbance of the functions awakened by it, are the only parts of the process which present a tangible character, and are susceptible of being appreciated, they are the only characters which can be safely adopted in framing a nosological arrangement, intended to embrace the essential characteristics of disease.

While pathological anatomy is thus fruitful in its illustrations,—while it thus fertilizes the whole range of etiology, symptomatology, diagnostics, prognostics, and even nosology, is it capable of rendering essential aid to therapeutics? Unless this question can be answered in the affirmative, all these alleged advantages will be of no value; for what signifies the most accurate knowledge of a disease, if that knowledge aid us not in the application of remedies for its mitigation or removal? But if it be admitted, that to be conversant with the nature of a malady, and to be able to interpret accurately all its phenomena, constitute the first and necessary steps towards the adoption of a proper course of treatment, the advantages capable of being extended to therapeutics by pathological anatomy, are incontestable. It is true, that it cannot be adopted as the only guide, and that in some diseases it cannot assist us;—it is true, that without its lights, Hippocrates, Aretæus, Sydenham, Baillou, De Haen, Stoll, Cullen, and others, merely directed by clinical observations, achieved important triumphs in the treatment of diseases, and enriched the science with works, which, although abounding in error, will hand down their names to the remotest posterity. Yet, for a want of a knowledge of organic lesions, how often were they misled in the application of their remedies! How often, influenced by the fallacious signs of debility, did they resort to active stimulation, or to perturbating remedies, where the

organs were affected with an intense disorganizing process; thus adding to the force of the malady, and hastening its fatal termination! To demonstrate the services which pathological anatomy is capable of rendering to therapeutics, let us take, by way of illustration, the physiologico-pathological conditions of one of the phlegmasiæ. In the inceptive period, the operation of the remote cause gives rise to a state of super-excitement of the affected tissue, which precipitates an inordinate quantity of blood upon the part, and a series of vital acts thus become instituted, which lead to the development of various changes of structure, new productions, or even to complete disorganization. What then is the object of the therapeutist? Taking the lights of physiological pathology for his guide, and, consequently, pathological anatomy, for we have seen that they are inseparable, he knows that if he quiets the nervous erethism, which is the first link in the morbid concatenation, he will prevent the subsequent fluxion; that when an influx of blood has already taken place, an abstraction of it will avert the changes of structure which would otherwise ensue, reduce the actions of the part within those limits which are compatible with their physiological relations, and thus prevent the development of induration, softening, suppuration, disorganization, transformations of tissue, new or heteroclite degenerations, which it is the natural tendency of inflammation to occasion. Being conversant with the organic and vital condition of the living structures, he knows that the whole of his efforts must be directed to invigorate their energies when they are languid, and restrain them when they threaten to surpass the proper bounds. He knows how to adapt the force of his remedies to the intensity of the disease; he has clear conceptions of the modifications of the vital acts which it will be necessary to develop, in order to arrest the march of the malady; and, capable of distinguishing between those affections which are incurable, and those which are within the controlling influence of the resources of the art, he knows when to limit his interference to a mere palliative course, and when it will be necessary to institute a more energetic treatment. All his efforts must, in short, be directed to second the conservative powers of nature; he should watch her salutary acts, and imitate them; and when he finds that she seeks relief by setting up a particular series of operations, his object should be to excite similar modifications by his remedial measures. If, then, this is to be his course; if he can only be prepared to act with advantage by an accurate knowledge of the condition of the diseased organ, and of the physiological modifications which are associated with it, the important services which pathological anatomy is capable of rendering to therapeutics are rendered indisputable, and both reason and experience demonstrate, that conjointly with clinical observation, it forms the whole foundation of the treatment of diseases.

But in showing what it is capable of accomplishing, should we not also advert to the errors which may arise from its misapplication or abuse?

We have only contended for the advantages which it is capable of furnishing, when fortified by clinical observation;—we only insist upon it as one means of forming correct principles, and not as the only one; for he who supposes, that merely to know that an organ has its colour changed, its volume altered, its texture modified, and its relations deranged, will furnish all the indications necessary to direct him in the treatment of the morbid phenomena to which its diseased condition gives origin, deludes himself, and sad experience must soon convict him of his error. Pathological anatomy has had such misguided votaries; and in their zeal to reduce everything to mere physical modifications of structure, they have abused the science, and attributed effects to causes altogether inadequate to their production. Every trivial and partial blush of redness; every appreciable modification of the size, form, or consistence of an organ; every insignificant tumour, excrescence, or ulcer; every accidental infiltration of a part with fluid,—is erected into a source of great and important disturbance of the healthy functions, and is appealed to in triumph as the fountain of all mischief, and the cause of death, when it had no participation in the phenomena of the disease, and is frequently a mere accidental post-mortem phenomenon. It is certainly true that the changes which take place after death often annihilate all traces of morbid organic phenomena, which, during life, exhibited a character of great intensity; yet it is equally incontestable, that mere cadaveric phenomena often similate so closely many organic lesions, as to render it difficult to discriminate between them, and to cause them to be confounded by those who are not accustomed to make autopsic examinations. The mechanical obstacles presented to the passage of the blood through the heart and lungs, during

the last moments of life; a similar condition produced by the suspension of respiration, in the acts of hanging and drowning, frequently occasions an extreme vascular injection, and consequent arborescent redness, which is apt to be mistaken for inflammation. The extreme facility, moreover, with which the fluids percolate the parenchymatous arrangement of the tissues, and the tendencies which they have to become collected in the most dependent part of the organs and regions of the body after death, often give rise to phenomena which might be mistaken for evidences of disease. It should likewise be remarked, that so soon as life is extinct, a play of chemical affinities is brought into operation; the solids and fluids are mutually acted upon by each other; the former lose their cohesiveness, and become softened and fragile; they are infiltrated by liquid and gaseous products, and have their properties extensively modified. Sometimes, indeed, so powerful is the action of the fluids upon the solids, that the latter are completely broken down by them, or are resolved into a complete homogeneous, diffluent pulp. Hence, it is not uncommon to find after death, the whole of the mucous coat of the stomach dissolved, and even its entire walls, as well as those of the intestines, presenting extensive perforations, when no evidences of disease of those parts were apparent during the life of the individual.

While, therefore, pathological anatomy is calculated to render such important aid in the difficult task of determining the characters and conducting the treatment of diseases, we must disabuse ourselves of a too implicit reliance upon it, to the exclusion of other considerations. It should be constantly borne in mind, that an infinity of organic lesions may be found after death, which have had no participation in the destruction of the individual, and that we are liable to be imposed upon by appearances, which only take place after death. We cannot have a better rule of conduct than the maxim laid down by Cruveilhier, "that every organic lesion which is not constantly observed as a consequence of any particular disease, should not be regarded as constituting an essential part of it."

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E. Geddings.

ANCHILOPS, Ankylops, or Ancilops. (Generally derived from αγχι, near, or αγχυλη, angle, and ωψ, the eye; but the derivation is unsettled.) Αγχιλωψ, Gr.; *Anchilops*, Lat. There has been much useless discussion respecting the exact meaning and proper application of this term, which is now nearly obsolete. The ancients appear to have applied it to all tumours at the internal angle of the eye, whether caused by disease of the lachrymal sac, or of the tissues covering this organ; it is, however, to designate tumours in the cellular tissue over the lachrymal sac, that it is usually employed. These tumours present themselves under two forms. The first is termed inflammatory anchilops, and consists of a small phlegmonous tumour, which is red, painful, and sometimes even attended with considerable

fever. The inflammation often extends to the eye-lids and conjunctiva; the puncta lachrymalia become completely closed, producing a constant stillicidium of the tears over the cheeks, and rendering the nostril of the affected side dry and so exceedingly sensible that the slightest irritation excites violent sneezing. The edges of the eye-lids and lachrymal caruncle secrete a tough viscid mucus, which agglutinates the lids together during sleep. Suppuration often takes place, and an abscess forms which discharges externally; or the anterior portion of the lachrymal sac becomes implicated, and the matter passes into this cavity, constituting the false fistula lachrymalis of Beer.

The second variety of anchilops is the encysted. This presents itself in the form of a round, hard, circumscribed, often indolent tumour, of variable size, situated above or below the tendon of the orbicularis muscle, rarely if ever immediately over it, and unattended at first with any redness of the skin. The development of this tumour is usually slow; and the impediment it offers to the free motions of the lids is the only inconvenience it occasions the patient. The tumour consists of a fibro-membranous envelope of variable thickness, inclosing a glairy ropy humour sometimes mixed with a yellowish pus. It often remains many years entirely indolent; sometimes it ultimately inflames, the matter is evacuated, and a small ulcer remains (*ægilops*).

Treatment. In inflammatory anchilops, an antiphlogistic treatment is to be employed. Cold applications, as cold water or lead water, will generally suffice, with mild purgatives, restricted diet, and occasionally small doses of Tart. ant. Unless the inflammation be very severe or extensive, bleeding will not be necessary. When suppuration is about to take place, the cold applications must be exchanged for warm poultices, to hasten this event; and the abscess should never be allowed to open spontaneously; but as soon as fluctuation becomes sensible, the matter is to be evacuated by incision with a bistoury, to preserve the lachrymal sac from erosion. When this last accident occurs, the surgeon should avoid introducing probes into the sac, and content himself with washing out the abscess daily by means of an Anels syringe, with tepid water, to which a little laudanum may be added; and afterwards applying a piece of lint wet with this medicament over the wound.

The abscess, instead of forming immediately above the lachrymal sac, sometimes is seated still higher up; in which case, if it be not early opened, or the opening preserved until the cure is complete, the pus may make for itself a passage above the sac and penetrate into the orbit, producing serious accidents, as, erosion of the periosteum, followed by caries of one or more bones of the orbit. This may be detected by means of a silver probe, or by the presence of red, fleshy, very painful granulations, which bleed on the slightest touch, and are sometimes developed at the opening of the fistulous canal. Such cases are usually of difficult management. The deep situation of the caries, as well as the proximity of the globe of the eye and the smallness of the fistulous canal, present difficulties to the employment of topical applications. If the separation of the carious portions of bone be trusted to the slight suppuration which occurs, exfoliation will not be effected in less than from six to ten months. In these cases, Weller recommends the external orifice to be enlarged, if possible, and the pus daily evacuated by carefully injecting a filtered infusion of rue (*Ruta graveolens*), with a little laudanum; and by afterwards introducing to the bottom of the fistula a lint tent steeped in a mixture consisting of one part assafetida and two parts solution of myrrh. Exfoliation may still more promptly be obtained, according to the same surgeon, by introducing to the bottom of the fistula a small quantity of the following mixture. ℞. Gum Assafetid.; Gum Myrr.; Terebinth. Venit.; āā ℈j; Ol. Sabin. gtt. v. ad viij. M. When the canal is contracted by fleshy granulations, they may be destroyed by the cautious use of nitrate of silver or of red precipitate. When, by these means, the caries is arrested, which may be determined by the probe, tents of lint wet with laudanum are to be for some time introduced a short distance within the fistula; and usually this passage ultimately closes of itself, leaving a small depressed cicatrix.

In encysted anchilops, if the cyst be small it should be extirpated; if it be large it must be laid open, which will sometimes suffice to effect a cure. If it should not, inflammation of the sac is to be excited to cause the adhesion of its parietes and its obliteration, by excising a portion of the cyst, or by touching its inner surface with mild caustics, or by filling its cavity with lint.

The *Anchilops erysipelatosa idiopathica* of Beer, *Anchilops erysipelatosa* of Weller, is an erysipelatous inflammation of

the internal canthus of the eye. The tumefaction is at first equally diffused, no particular hardness exists, the affection does not differ from erysipelas in other parts of the body, and requires no particular notice here. The inflammation, however, sometimes extends to the anterior portion of the lachrymal sac; a painful, circumscribed tumour forms, which, if not dissipated, terminates in suppuration; and the treatment here is the same as that which we have recommended for inflammatory anchilops, of which it is one of the forms.

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I. H.

ANCHUSA. (*Botany.*) *Bugloss.*—*Buglosse*, Fr.; *Ochsenzunge*, Germ.

Sex. Syst. Pentandria Monogynia. *Nat. Ord.* Borragineæ.

Gen. Ch. *Calyx* five-cleft, persistent. *Corolla* funnel-shaped, with a half five-cleft, spreading limb; orifice closed with five prominent scales. *Anthers* included. *Stigma* emarginate. *Seeds* gibbous, with a sculptured surface. Lindley.

1. *A. Italica.*—*Italian bugloss.*—*Sp. Ch.* "Leaves shining, strigose; racemes bipartite, diphyllous; flowers subequal, bearded at the throat." Willd. *Sp. Plant.*—This species of Anchusa is a biennial, hairy plant, with a branching stem about two feet high; alternate, linear-lanceolate leaves; and five blue flowers, disposed in a loose panicle, formed of one-sided, twin racemes. It is a native of the south of Europe, and is abundant in France, where it is employed instead of the officinal bugloss, (*A. officinalis,*) which it closely resembles in properties, and which does not grow in that country.

2. *A. officinalis,*—*Officinal bugloss.*—*Buglosse officinale*, Fr.; *officinelle Ochsenzunge*, Germ.—*Sp. Ch.* "Leaves lanceolate, strigose; spikes one-sided, imbricated; calyx as long as tube of corolla." Lindley.—The root of the officinal bugloss is biennial or perennial; the stem, from one to three feet high, and branching at top; the radical leaves, petiolate, entire, often from six to ten inches long by an inch and a half broad; the cauline leaves, small and sessile; the flowers, at first violet-red, afterwards blue, and disposed in one-sided, recurved spikes or racemes. The whole plant is rough and hairy. It is a native of Germany, Great Britain, and other parts of the north of Europe. It was formerly employed, to a considerable extent, in medicine. All parts of the plant were officinal. They are without odour, and nearly tasteless. The leaves are mucilaginous when chewed; the root, sweetish and highly mucilaginous; the flowers, slightly bitterish. By the ancients the plant was deemed cordial and exhilarating, and was used in hypochondriacal affections; but as it was taken in wine, its supposed effects were no doubt ascribable to the vehicle. The flowers were ranked among the *four cordial flowers.* In later times, bugloss has been considered aperient and refrigerant, and has been used in complaints of the chest, cutaneous affections, rheumatism, &c. At present, however, it is believed to be nearly inert, and no longer holds a place in the British pharmacopœias. In this country, it is never employed in regular practice; though the plant is sometimes cultivated in gardens. The fresh expressed juice, or a decoction of the plant, may be given *ad libitum.*

3. *A. tinctoria.*—*Dyers' bugloss, Dyers' alkanet.*—*Buglosse tinctoriale, Orcanette*, Fr.; *färbende Ochsenzunge, falsche Alkanne*, Germ.—*Sp. Ch.* "Leaves oblong; bractes longer than the five-parted calyx; valves of the corolla shorter than the stamens." Lindley.—This is a perennial plant, with round, rough, hairy, branching, lax, herbaceous stems, from six inches to a foot or more in height, furnished with lanceolate, obtuse, hairy, sessile leaves, and terminating in bracteate spikes bearing reddish-purple flowers. It grows in the Morea, Cyprus, and other parts of south-eastern Europe. The root is officinal under the name of alkanet. (See *Alkanet.*)

Geo. B. Wood.

ANCHYLOBLEPHARON, Ankyloblepharon, or Ancyloblepharon. (From αγκυλος, a hook, and βλεφαρον, an eye-lid.) Αγκυλοβλεφαρον, Gr.; *Aucyloblepharon*, Lat. The cohesion of the margins of the eye-lids. This term has been also applied to the union of the lids to the globe of the eye; an affection, of which we shall treat under its more appropriate title, *Symblepharon*, (q. v.).

Anchyloblepharon may be imperfect, a portion only of the margins of the lids coherent, and this occurs generally at their temporal extremities; or perfect, the mar-

gins of the lids united in their whole extent. This last form is so infrequent, that GUTHRIE doubts its ever existing except as a congenital affection. The union between the lids may be close and immediate, or lymph may be effused on their edges in considerable quantity, and become organized, forming a whitish firm membrane, occupying and obliterating the natural opening.

Causes. Whatever produces excoriation or ulceration of the tarsi may occasion anchyloblepharon; for if the opposed lids, in this condition, be kept in apposition, the process of union is apt to take place. The most common causes of this affection are traumatic lesions arising from burns, concentrated acids, quicklime, acrid substances, &c. WELLER has seen it result from an ulcer of the internal angle, extending to both lids, and the margins of which contracted close adhesions, having been kept in contact by a tight bandage. It also occasionally follows psorophthalmia, small-pox, &c. In very old persons the edges of the eye-lids sometimes gradually adhere from their external towards their internal angle, so as to exceedingly contract the opening. CLOQUET and ROSTAN have each met with several examples of this, in which the opening was so small as scarcely to enable the patient to see sufficiently to find his way. (*Dict. de Méd.* I. 438.) In some rare cases anchyloblepharon is congenital, and it here no doubt results from inflammation of the lids during uterine life.

Diagnosis. Anchyloblepharon cannot be confounded with any other disease, but it is important to ascertain whether or not it be complicated with symblepharon, and there be opacity of the cornea; for the patient would yield little thanks to the surgeon for exposing, by an operation, a disfigured and useless eye. When the anchyloblepharon is imperfect, the existence of symblepharon may be determined by introducing through the opening a flexible probe of silver or whalebone, and moving it between the eye and lids. A simpler method, and one which answers equally, whether the affection be partial or complete, consists in taking hold of the eyelids with the thumb and fore finger, and raising them from the ball, at the same time instructing the patient to move his eye in different directions. If there be no adhesion between the eye and lids, the motion of the former is free; if, on the contrary, adhesions exist, the motions of the organ, and the separation of the lids from it, are prevented. The patient being able to distinguish light, affords evidence of there being no adhesion between the cornea and palpebræ; an entire insensibility to light, affords presumption of a disorganized state of the cornea, and evidence of the inutility of an operation.

Prognosis. When not complicated with symblepharon, the prognosis in this affection is favourable; and especially so when the adhesions exist only at the middle of the palpebral margins, or when the union is by an intermediate membrane. The partial adhesions which exist at the commissures of the lids, especially at the external commissure, are readily renewed after the operation, requiring particular attention on the part of the surgeon, in the subsequent treatment.

Treatment. The only means of cure consists in the operation of separating the lids with a cutting instrument. This can be conveniently effected by various methods. In imperfect anchyloblepharon, the lids may be separated with probe-pointed scissors, as performed by MAITRE JEAN; or a flat probe may be introduced beneath the lids, and the adhesions divided upon it with a common scalpel, as recommended by GUTHRIE. The method most usually adopted is to pass through the interval in the lids, a small grooved sound, bent to accommodate it to the natural curvature of the eye, and then to separate the lids with a bistoury passed along this director, the whole extent of the adhesion. BEER'S plan is as follows. He takes hold of a cross fold of skin, with the fore finger and thumb of his left or right hand, as the case requires, whilst an assistant draws the upper lid outwards and upwards in the same manner. A small blunt-pointed bistoury is then introduced at the inner canthus, and made to cut its way slowly out towards the external angle, without injuring either eye-lid. If the adhesion be through the medium of a membrane, the incision is to be carried along the edge of the upper lid, and the membrane attached to the lower lid must be cut away with scissors.

In complete anchyloblepharon, the lids should be raised up into a fold, as just recommended, and an opening made in the line of union, by an incision with a bistoury transverse to this fold. Surgeons differ in opinion as to the best point for making this opening. SANSON selects the internal commissure: CLOQUET prefers the external one on account of the puncta lachrymalia, which he thinks are then less liable to be injured; and further, because the projection of the nose often renders

the introduction of the sound at the internal angle inconvenient: MACKENZIE makes the opening at the centre of the commissure. The point selected appears to be of no great moment; that which is most convenient to the surgeon, and best adapted to the particular case, may be adopted. Advantage is then to be taken of this opening, to complete the operation by one of the methods just described.

The operation being completed, it only remains to prevent readhesion. The best measures for this purpose consist in washing the wound with an astringent liquid, as rose-water, with sugar of lead dissolved in it; or by slightly touching the wounds with sulphate of copper, and frequently washing them with warm water, and subsequently smearing them with some unctuous substance, as the ung. ox. zinc. BEER advises also, that the patient should sleep soundly the night before, so as to be able to remain awake the night after the operation; it may be sufficient, however, to awake him frequently, and direct him to open widely his lids, so as to prevent their adhesion. When the adhesions are at the centre of the margins of the lids, these measures are usually entirely effectual; but when seated near either of the commissures, they often fail in part, rendering it necessary, for entire success, to repeat the operation several times.

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I. HAYS.

ANCHYLOGLOSSUM. (From αγχυλος, a hook, and γλωσσα, the tongue.) Abnormal connexion of the tongue and mouth, restricting the motions of that organ, and arising either from shortness of the frænum, or from the presence of an adventitious membrane extending from this part to the tip of the tongue (see *Tongue-tie*); or from adhesions between the mucous membrane of the tongue and that lining the cavity of the mouth (see *Mouth*). I. H.

ANCHYLOSIS. (From Αγχυλος, crooked, bent.) A permanent immobility of joints naturally movable. The derivation of the word would also imply an angular position of the bones, but the term is probably merely indicative of the fact that in the early observations of the Greek physicians, the bones were found in this relation; at least in the joints most subject to this affection, as the elbow and knee.

Anchylosis is distinguished into complete and incomplete, according as the articulations have lost entirely their motion, or as a slight degree of it is preserved. Most commonly, anchylosis is the result of acute inflammation; but it also is produced by a joint being kept an undue length of time without motion, as in surgical dressings—in rheumatism—in paralysis—from cicatrices—contraction of muscles—or from choice, as among the fakirs of India, who, under certain ideas of devotion, hold a limb so long in the same position that it becomes permanently rigid. The diseases which give rise to this affection in most instances are complicated fractures of the joints, dislocations, sprains, hydrarthrosis, white swelling, rheumatic or gouty inflammations, and a spontaneous ossification of the ligaments. In young persons, anchylosis is for the most part the result of active arthrodial inflammation from some of the causes stated; whereas the spontaneous cases exist in persons of an age somewhat advanced; there is, however, no invariable rule depending merely on age.

In anchylosis from mere immobility, the immediate cause is a cessation of the secretion of the synovial fluid, and a rigidity of the capsular and funicular ligaments, to which may be added, a dryness of the tendinous sheaths, and an inspissation of the surrounding cellular substance. Some of these cases present a fixedness of the joint as firm as that arising from the actual fusion of the contiguous bones into each other, and not susceptible of being distinguished by external examination alone.

The spontaneous ossification and disappearance of individual joints is by no means unusual, and prevails chiefly in those of the smaller toes: the writer has often observed it in negroes. The next in liability are the other joints of the foot, and then those of the hand. The vertebral column may be considered as subject to this affection. There are also a few remarkable cases on record of this condition existing in all the movable joints of the same individual. An infant of twenty-three months, whose history is recorded by the Academy of Sciences of France, (anno 1716,) presented an instance of it. Mr. LARREY, of Toulon, exhibited to the

Faculty of Medicine of Paris, the skeleton of a fisherman in whom almost all the joints were in this state; and in the year 1802, an officer died at Metz, in whom it was universal. This last case, reported by Percy, resulted from an inflammatory rheumatism contracted by exposure during a campaign in a cold humid country. The skeleton, which is now deposited in the anatomical cabinet of the School of Medicine of Paris, is seen to constitute but a single piece. Even the articulation of the lower jaw has disappeared, which rendered it necessary during the life of the individual, to extract two incisor teeth, with the view to an opening into the mouth, for the introduction of aliment.

Diagnosis. The characters of anchylosis are so well defined that there is but little difficulty in distinguishing it, the complete or partial immobility of the joint being sufficiently indicative. Some degree of attention is, however, expedient in developing the diagnosis; because it occasionally occurs that joints are in a state of inflammation or sensibility, making the least motion painful, and where an instinctive tonic contraction of the surrounding muscles follows any attempt on the part of the surgeon to make the joint execute its natural movements.

Though anchylosis may be readily distinguished from other affections of the joints, yet if these be perfectly immovable it is difficult to determine whether the disease is a mere rigidity of the soft parts, or an absolute and perfect union of the contiguous bones. The attending circumstances will assist the judgment; for instance, if they consist in a fracture of the joint, followed by violent inflammation—if the joint has been opened by a gun-shot wound—if the bones were carious formerly—these several conditions present strong evidence of their complete fusion; and especially if to them be added, a dryness of the joint—a sense of inequality on the surface of the new callus—and absence of pain when an effort is made to bend forcibly the joint. On the contrary, if the anchylosis be incomplete, tumefaction and engorgement are perceptible, and severe pain follows a forcible effort to move the joint. It is of great importance to distinguish between these two species of anchylosis, since the complete is incurable, and in many cases efforts at a cure may be highly inconvenient and even injurious; while, on the contrary, the incomplete or false anchylosis is, in its early stages, almost always susceptible of cure, though if neglected it becomes incurable.

The following may be considered as the most common condition of joints in the various species of anchylosis.

1. *Anchylosis from want of motion.* Frequent motion being necessary to preserve the flexibility of every joint, and to keep its ligaments of a proper length, size, and consistence, as well as to promote the proportionate discharge of synovial fluid, it happens that undue rest dries up this fluid or alters it into a simple serous exhalation; the contiguous surfaces of the synovial membrane lose their polish, become rough, and finally contract adhesions with each other, and in progress of time this membrane is converted indeed into a mere cellular substance, scarcely presenting a vestige of its original character. The articular cartilages become thinner, and ultimately wholly disappear. For a long time the spongy substance of the two bones is kept apart by a thin plate of cartilage and of compact substance; but the final stage, which is that of complete ossification, resembles the junction of an epiphysis with the body of a bone, and scarcely a trace of the original separation remains. M. Cloquet, in the article on Anchylosis, in the new edition of the Dictionnaire de Médecine, informs us that he has repeatedly verified the preceding stages on paralyzed persons who had remained for a long time in bed in one position, and that he has never seen a trace of that inflammation in the synovial membranes, the existence of which is very commonly alleged, but perhaps on hypothetical grounds.

2. *Anchylosis from false membranes.* When inflammation has assailed a joint, especially the knee, the synovial membrane, like the pleura and peritoneum, deposits a layer of coagulating lymph, which forms bridles through the joint, and occasions an adhesion of surfaces naturally free. These adhesions are at first soft and gelatinous, but they in progress of time acquire consistence, and are converted into cellular substance. The synovial fluid, which, in the early stage of the affection, was in excess, is afterwards entirely removed, and, as a final change, ossification invades the whole soft structure constituting the joint, just as in anchylosis from immobility.

3. *Anchylosis from softening and removal of the articular cartilages, in consequence of scrofulous inflammation and caries of the ends of the bones.* This is the most common condition of a joint

leading to anchylosis; and in this case when a sanative process succeeds the preceding destruction of parts, the ends of the bones shoot forth granulations which adhere as in a common sore, and finally ossify, so that the contiguous bones are continued into one another, after a process very analogous to the union by granulations in a compound fracture. This process is, however, very much retarded in many instances, by fragments of detached bone, and by fistulous passages leading through the granulations.

4. *Anchylosis from ossification of the interosseous cartilages.* Wherever a fibro-cartilaginous junction exists naturally between bones, as in those of the spine, there is a disposition to ossification, in advanced age; this is favoured both by the character of the tissue and by the small degree of motion. The ossification is seldom so perfect as to invade the whole intervertebral matter, the pulpy part being commonly left untouched, while bone invades the most fibrous portion which is in front. In some rare cases, the whole vertebral column has thus been converted into a single piece. M. Seraphin, the inventor of a celebrated pastime for children, in Paris, consisting in optical illusions, called the Chinese Shades, is said to have presented this peculiarity. (Cloquet. Art. *Ankylosis*, in Dict de Méd. 2d ed.)

Treatment. Whatever may be the disease tending to anchylosis, it should of course be treated by its appropriate remedies, which will be found under their proper heads. The preliminary affection being ended, and the anchylosis itself established, the subsequent management must depend upon the latter being incomplete or complete.

Incomplete anchylosis is almost always susceptible of cure, if it be taken in an early stage; its intractability is increased by duration, and is greater in the ginglymoid than in the orbicular joints. It is also more manageable when the consequence of protracted rest than when it results from a morbid derangement of tissue. From the pliancy and succulency of the fibrous membranes in infancy, this may be considered as a favourable period of life for a cure.

The rigidity of ligaments, and the retraction of the muscles, being the common opponents to the relief of incomplete anchylosis, the indications are, therefore, to restore flexibility to the former, and extension to the muscles. These may be accomplished by making frequently gentle flexions and extensions of the limb, conjoined with simple or medicated frictions over its whole length. Among the applications which experience has sanctioned are warm lotions, vapour baths, and streams of hot water from the mouth of a kettle. The hot springs of Virginia, which are used both as a bath and by suffering a stream to impinge on the body, are justly distinguished for their salubrious effects in stiffness of the joints from rheumatism and from incomplete anchylosis. Warm or hot bathing may be rendered more efficient by impregnating the water with common salt, muriate of ammonia, the alkalies, and sulphur. Frictions with olive oil, plain or joined with camphor—with saponaceous liniment, or opodeldoc; fomentations of an emollient kind, as a decoction of marsh mallows or flaxseed, or of the tripe of an animal, are very serviceable. The French surgeons place much reliance on a species of fomentation obtained by applying to the joint some portion of an animal just killed. Thus, M. Boyer (*Malad. Chirurg.* IV. 571.) recommends the plunging of the affected part, if conveniently situated, into the body of an animal the moment it is opened; or else, taking the omentum or skin of a sheep just slaughtered, and wrapping it around the part for some hours.

Two or more of these means may be used at once, and should be repeated for at least half an hour twice every day. When some relaxation is imparted to the joint, its motions should then be sedulously attended to, by conforming them to the character of the articulation: thus, flexion and extension will answer for the hinge-like joints, while circumduction and rotation must in addition be used in the orbicular. The motions ought to be very gentle at first, and extended gradually from time to time, to the greatest amplitude admitted by the form of the articulation. An abrupt force causes pain and may reproduce inflammation. In the early trials, a crepitation and grating will be heard, arising from the want of synovia and the friction of the rough articular surfaces together, and also from the elongation of the ligaments and the preternatural adhesions; but as the joint approaches the normal state, the increased secretion of synovia and the softening of the surrounding parts make the motions smooth and without pain. These primary motions should be made by the surgeon himself, or by a skilful attendant.

Where the anchylosis is very ancient and the retraction of the flexor muscles extreme, in addition to the above it is re-

commended by the authority of FABRICIUS, HILDANUS, BOYER, and others, to resort to a machine, the invention of the former, by which a constant extending force is maintained upon the limb. A splint and bandage may be used to this end on the lower extremity, and the frequent holding of a weight in the hand will answer for the upper extremity.

In the progress of a malady, when it is obvious that complete anchylosis must follow, it is important to fix the limb in that position which is most favourable for its subsequent use: thus, the lower jaw should be a little depressed; the thigh and leg extended; the foot at right angles with the leg; the toes extended; the arm drawn downwards and somewhat out; the fore-arm flexed at right angles with the arm, and with its two bones parallel; the hand in a line with the fore-arm; the fingers semi-flexed; the thumb slightly out from the fore finger, with the second phalanx bent as in holding a pen. The head should be set at right angles on the vertebral column.

Notwithstanding the general rule of complete anchylosis being incurable, some few cases have occurred in the surgical history of our own country, showing that it is not invariably so. The most remarkable exception, is the case of a patient in the Pennsylvania Hospital, affected with anchylosis of the hip joint, on the right side, attended with an inconvenient crossing of the os femoris to the other side, and who was operated on by Dr. J. RHEA BARTON, in 1826. In this instance the bone was sawed through a little below its neck, and the limb straightened. In twenty days after the operation, motion was instituted and kept up so as to make an artificial joint, which at the end of four months seemed to have succeeded, the wound necessarily caused by the operation having previously got well. (*North Am. Med. Journal.* III. 279, and 400.)

The following supplementary communication from Dr. BARTON to the Editor, will give the best idea of the consequences and condition of this case till within a short period:

"Dear Sir,—In reply to your note of inquiry on the subject of the case in which by an operation I had succeeded in remedying the distortion and lameness of a limb, and in establishing an artificial joint at the hip, as a substitute for the natural one, which had been destroyed by anchylosis, I can inform you, that for six years I kept a watchful eye on the individual operated on; and during this period had opportunities of inspecting the part. Within the first year the patient had been exposed to occasional attacks of inflammation; induced sometimes by contusions, and at other times by the undue and fatiguing use of the limb. The consequence of this early and repeated irritation of a part which had so recently undergone such treatment and alteration of structure, was, that much thickening at the hip, and a diminution of the latitude of motion in the joint, resulted. Nevertheless, when I last saw him, which is about two years ago, he walked surprisingly well, without a crutch or even a cane. There was to be observed in his movement scarcely anything indicative of the change which had taken place. But, though at this period the limb was straight; without any further shortening, and was strong and useful; the motion in the artificial joint had become much restricted by the thickening of the surrounding ligaments, thus binding the articulating surfaces so closely together as to admit of but little motion on each other. Yet this, conjoined with the enlarged motion which he had acquired previous to the operation, between the lumbar vertebræ, and with the accommodating motions of the opposite side, gave to him the enjoyment of a limb free from contraction and firm, and useful enough for all ordinary purposes.

Within the period of the six years, I frequently used to meet the patient in the streets, walking with a quick and easy pace. At one time he was engaged in soliciting subscriptions to some literary productions, but subsequently he returned to his trade.

I regret that I have not been able to see him for the past two years, or to learn whither he has gone; that I might be able to inform you of the present condition of the joint. But my apprehensions were that ultimately the motion of the joint, if not entirely lost, would not be of any material extent; though in the permanent value of the operation to him in all other respects, I had the fullest confidence.

Should another case of a similar kind present itself, I would repeat the operation; but with such modifications as my experience in the first case, and my subsequent reflections on the subject, have warranted me in believing would effectually prevent any final diminution of the acquired motion; viz. by substituting an oblique for a transverse section of the bone.

Within the last three years I have succeeded in re-establishing a joint at the ankle, in the case of a gentleman (Mr. B. Bullock) of this city, who, by an accident, had the misfortune to suffer a compound dislocation and fracture of the ankle joint, followed by the entire loss of full two and an half inches of the inferior extremity of the tibia, including its articulating surface. The fragment is preserved in my collection—and the gentleman, who has not been under treatment for the last two years, has been, and is now, in the

enjoyment of sound health, and of a good limb which he uses unaided even by a cane.

In this case, a quantity of bony matter was secreted, as well from the inferior extremity of the fibula, as from the tibia itself, which would have terminated in true anchylosis, but for the motion to which I had subjected the part, as early as the state of the limb admitted of it; thus applying the same principle of practice to the re-establishing of the motions of a fractured joint, which had influenced me in the formation of an *artificial* joint. With much respect,

Yours,

J. Rhea Barton.

Dr. Hays.

Philada. July 3, 1834."

Three cases of incomplete muscular anchylosis of the articulation of the lower jaw have been successfully treated by Dr. Valentine Mott, of New-York. In the first case, (*Am. Med. Journal.* V. 102.) the individual had been in that situation for ten or eleven years, the condition having been produced by the loss of the small and large grinding teeth on the left side of the lower jaw, together with a large piece of the jaw itself. A ligamentous cicatrix, of an extremely firm character, had occurred between the cheek and the jaw bone in this region, so that only a little lateral motion could be imparted to the jaw. The cheek was cut through to the coronoid process, and the adhesions to the upper and lower jaws detached; the jaw was then forced down by an ingenious lever, and the mouth kept open with it or a piece of wood, till the wound healed. The natural motions of the jaw were finally renewed, and the patient could masticate freely, and engage in conversation with a distinct articulation.

The details of the second case are wanting, but it is reported in general terms to have been similar to the first. Dr. Mott's third case arose from a slough of the cheek, two inches in diameter, which, upon cicatrization, held the jaws immovably together, and caused the necessity of extracting a tooth from the other side of the mouth, for the introduction of food. As there was a considerable loss of substance here, the common method of cutting up the adhesions would not have been sufficient to provide for the opening of the mouth: the Doctor, therefore, by an application of skill the most creditable, removed the cicatrix, and by a Taliacotian operation brought a portion of the integuments of the lateral part of the lower jaw to supply the place of the destroyed cheek. The treatment seems to have succeeded most happily. (See *Am. Med. Journal,* IX. 47.)

Dr. Mighels, of Maine, (Id. p. 50.) has also succeeded in restoring motion to the lower jaw, where it had been almost lost from an adhesion, of a ligamentous kind, extending from the cuspate tooth to the coronoid process on the left side. The adhesion was the result of mercurial ulceration. The division of the adhesion, without cutting through the skin of the cheek, was sufficient in this case, the jaws having been forced asunder by a lever introduced between the teeth, and acting with great energy by means of a screw: a similar instrument had been resorted to by Dr. Mott, in his cases.

The preceding instances of immobility of the lower jaw do not come accurately under any of the ordinary scholastic divisions of anchylosis, but are cases apart, arising from the peculiar relations of the bone, and such as would not occur elsewhere. When the adhesions were removed, the main difficulty of putting the joint in motion appears to have arisen from the muscles not having their customary power, and not from any change in the joint itself; so that the term anchylosis is at least equivocal, meaning here rather a condition of the parts around the joint than of the joint itself. W. E. Horner.

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I. H.

ANCONEUS. (From αγκων, the elbow.) An epithet formerly applied to all the muscles attached to the olecranon. (See *Muscles.*) I. H.

ANDA. (*Botany.*)

Sex. Syst. Monœcia Monadelphia. *Nat. Ord.* Euphorbiaceæ.

Gen. Ch. *Calyx* short, five-dentate.

Corol. monopetalous, four times the length of the calyx. *Fruit* 2-celled, 2-seeded.

This plant, which is the only species of the genus, was first described by Piso, under its native name of *Anda.* It however remained unnoticed by succeeding botanists until Gomes (*Obs. bot.* 1.) gave an account of it, and erected it into a new genus, on which he bestowed the name of *Joannesia*; this being, however, preoccupied, A. Jussieu restored its original appellation of *Anda*, calling it *A. brasiliensis.* The bark is lactescent and poisonous, and is used in Brazil for stupefying fish. The part used in medicine is the fruit, which is about the size of an apple, and of an ash colour. On removing the external husk, a nut is presented to view, which is about two inches in diameter. It has a hard shell, which, on being broken, exhibits two cells, each containing one seed about the size of a chestnut. These seeds are cathartic, in doses of from one to three, and are much used by the natives of Brazil. The external husk is employed as an astringent in diarrhœa, and also to moderate the effects of an over-dose of the kernels. By expression, these seeds furnish a clear, pale yellowish oil, which is destitute of taste and almost of smell; at common temperatures it is as fluid as olive oil, and is used in Brazil for burning, for painting, and, by the Indians, for anointing their bodies. From experiments made with it in the Pennsylvania Hospital, by Dr. Norris, it appears that in doses of 50 drops it generally induced one evacuation, and in larger quantities operated copiously. Like all other remedies furnished by the Euphorbiaceæ, it will often act on the stomach, and cause nausea.

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R. E. Griffith.

ANDIRA. (*Botany* and *Mat. Med.*)

Sex. Syst. Diadelphia Decandria. *Nat. Ord.* Leguminoseæ.

Gen. Ch. *Calyx* urceolate, entire or five-dentate. *Corolla* two-petalled. *Drupe* fleshy, ovate, one-seeded. Gmelin.

This genus was separated from *Geoffroya*, and includes those species included by Linnæus in the latter, which have papilionaceous flowers, and a fruit without valves. At the same time, as is justly observed by De Candolle, these two genera are scarcely distinct, and neither of them can strictly be considered as belonging to the Leguminoseæ, on account of the character of their fruit, which is analogous to that of the Amygdaleæ. All the species of *Andira* are possessed of medicinal properties of different kinds.

1. *A. inermis.* Cabbage-tree. *Geoffroya de la Jamaique*, Fr.; *Wurmrinde*, Germ.

Sp. Ch. Unarmed; leaflets lanceolate. Willdenow.

This species is found in many parts of South America and the West India islands. It is a tall tree, branching at the summit, with pinnate leaves, of four or five pairs of lanceolate, acute, smooth follicles; the flowers are in clusters, of a pale rose colour; the fruit somewhat resembles a small plum; it is marked with a longitudinal furrow, and contains a hard stone or seed. The part used in medicine is the bark, which, as found in commerce, is in long, thick, fibrous pieces, externally of a brownish-ash colour and generally coated with lichens, internally yellowish; it has a resinous fracture, a disagreeable smell, and a sweetish, mucilaginous, bitterish taste. This bark was long employed in Jamaica and elsewhere, as an anthelmintic, before it was known in Europe, where the first account of it was published by Mr. Duguid (*Phys. and Lit. Essays*); after which it attracted considerable attention, and numerous testimonies in its favour appeared in the periodicals of the day; among others, Dr. Rush speaks of it in the highest terms. "I have," says he, "used above thirty pounds of it, and have never found it to fail in one instance." The fullest account that has been given of it is that of Dr. Wright. (*Philos. Trans.*) Notwithstanding these encomiums, it is now seldom or never employed, except in the West Indies. It was used in powder, decoction, or extract; in all of which forms it was necessary to be cautious not to administer an over-dose, as from its poisonous qualities it was liable to produce vomiting, superpurgation, fever, &c. The dose of the powder is from a scruple to half a drachm, of the extract 3 to 10 grains, and of the decoction a table-spoonfull two or three times a day, till the desired effect is produced.

It is said that cold water should not be drunk during the operation of this medicine. The fruit, or rather the kernel of the nut, has also been recommended as a vermifuge, in doses of a scruple or more, and is said by Piso to be very active, though

experiments made at Paris have not confirmed his assertion: this may have arisen from the nut having lost its active properties by age.

2. *A. surinamensis.* Decan. *A. retusa.* Kunth.

Sp. Ch. Unarmed, leaves ovate, obtuse or retuse; carina two-petalled. Bondt.

This species, which is also a native of South America, furnishes a bark possessed of the same qualities as the *A. inermis*, except that they are not quite so active. As found in commerce, it is in flattened pieces, of about a foot long, and several inches wide, grayish externally, and reddish-brown within, with brown striæ and spots, between the layers. It is used in the same manner and in about the same doses as the last. Both these species have been analyzed by Dr. Huttenschid, who discovered in them two new substances of an alkaloid nature, to which he gave the names of *Jamaicine* and *Surinamine.*

There are several other plants of this genus, which have also been used in medicine. The *A. racemosa*, found in South America, according to Dr. Hamel is almost identical in its effects to the *A. inermis*, and, as in that species, the nut is vermifuge in doses of a scruple. The *A. Horsfeildii*, a native of Java, enjoys much reputation as an alexipharmic, and is also considered by the natives as an excellent stomachic.

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ANDROGYNOUS. (From αvηϱ, a man, and γυνη, a woman.) ανδϱογυνος, Gr.; *Androgynus*, Lat. Hippocrates applied this term to effeminate men, but it has been most generally employed to designate the union of both sexes in the same individual, or *hermaphrodism* (q. v.). Some naturalists make a distinction between hydrogynous and hermaphrodite, applying the former to animals provided with the organs of both sexes, but who cannot fecundate themselves; and the latter to animals who unite both sexes, and are able to fecundate themselves, without uniting to another of their own species. Phytologists term those plants androgynous, which possess both sexes in the same individual, though on separate and distinct flowers; and those hermaphrodite in which the organs of both sexes are united in the same flower. I. H.

ANDROMANIA. (From αvηϱ, a man, and μανια, madness. Passion for men. (See *Nymphomania.*) I. H.

ANEMIA, Anæmia, Anhæmia, or Anaimia. (From α, priv., and αιμα, blood.) Defectus sanguinis; deficiency of blood.

From the earliest eras of medical science, its doctrines, never fixed, have manifested a pendulum vibration, swaying to and fro, from one extreme passing to its opposite. For a long period, the blood and humours exclusively occupied the attention and engaged the speculative investigations of medical observers. The organs or solids were forgotten, and as little attended to in the investigations of pathologists, as though uninstrumental in the phenomena of life. The doctrine of solidism, engendered in the brilliant conceptions of Baglivi, Glisson, and Sydenham, embodied and expanded into a system by the philosophic inductions of Hoffman, Cullen, Haller, Brown, and Bichat, threw into so deep a shade the concurrence of the fluids in the offices of vitality, as to sink them into an insignificance rivalling that of the solids during the humoural domination. The opposite movement has commenced. The value of the fluids, as agents in vital phenomena, and their efficiency in the production of disease, is beginning to be recognized. Laennec, as regards phthisis and some other organic diseases, is decidedly a humouralist. Velpeau, Bouillaud, and Roche, carry the doctrine still farther; and Delens is so entire a humouralist, that he contends for the humoural origin of all diseases; while Drs. Stoker and Burne advocate exclusively the humoural origin of typhus fever. In this, as in most other subjects, the middle ground is the true one; it is that of nature, which abhors *exclusiveism*, as much as by the scholastics of old she was made to abhor a vacuum. The blood—that is the fluid of nutrition, white as well as red—is a "part and parcel" of each organ; it is organic; the structure is not complete without it, and every modification it experiences, either as to quantity or quality, is a modification of the vitality, the structure and organization of an organ. The fluids then are participators of the pathological

condition, and no pathological doctrine can be trusted to, in which they are wholly neglected.

The consideration of the blood, its properties, chemical composition, uses, &c., will constitute the subject of a special article. (See *Blood.*) It is only necessary here to invite attention to the following facts, the details respecting which will be found elsewhere. The blood contains albumen, fibrin, colouring matter (hematosine); according to Vauquelin and Chevreul, a yellow fat matter similar to the substance of the brain (neurine); various saline principles, and water, the menstruum of some, and vehicle of other, of these principles. These various matters are not combined in the blood, in a chemical union, but are mixed, as so many heterogeneous bodies. The blood, when seen in the act of circulating, exhibits the appearance of globules, moving in a transparent medium. The colouring matter and globules are intimately connected. The blood is never constant in its composition. Its elements are derived exterior to itself, while they are incessantly expended in the nutrition and secretions of the economy. It is dependent on supplies obtained from external nutritive substances; and these, before their conversion into the sanguine fluid, require the preparative operation of numerous organs. The incapacity to obtain nutritive matters, in sufficient quantity, or of proper quality; or the perversion and suspension of the functions whose action is necessary for their assimilation into blood, by disease of the organs; are all causes by which the blood is exposed to profound and essential changes in its composition, characters, and properties. To the above causes are to be further added the losses and impoverishment of the blood from hemorrhages, from profuse and exhausting evacuations and secretions casting off and wasting the materials of nutrition.

In the course of my own observation, I have met with two instances exhibiting the blood nearly deprived of colouring matter and globules, in consequence of excessive hemorrhages from hemorrhoids. In a third, the same condition was induced by the abuse of the lancet. In these cases the blood scarcely stained the linen on which it fell.

Dutrochet mentions that having kept a salamander some months without food, the globules of blood diminished, and at length disappeared. The experiments of Collard de Martigny demonstrate unequivocally the changes induced in the composition of the blood by abstinence and innutritious food.

Anemia is a term that designates a modification produced in the blood by some of the before-mentioned causes. In its strict acceptation, it signifies absence or deficiency of blood. But it is employed more frequently to indicate a partial deficiency of the blood, particularly of the colouring matter and fibrin.

The condition of the blood now designated as anemia doubtless always existed. The term has been employed in medicine only within the last century and a half, and has not been of frequent employment until within the last twenty years. The affection, now known more correctly, was formerly classed under the vague denominations of Cachexia, Leucophlegmatia, and Chlorosis. The occurrence of the disease amongst the labourers of the coal-mine of Auxaine, and the investigation then instituted by the Royal Academy of Medicine of Paris, has established its true character, and given it a location in nosology as well as a name. By practical observers, whatever closet speculators may aver, its existence is not doubted, nor difficulty experienced in detecting it.

Anemia, in the enlarged meaning of the term, embraces two conditions of the blood. The first is deficiency of the whole mass of the sanguine fluid; the second is the absence or deficiency of some of its principal and essential elements.

The causes productive of anemia are various and numerous. Some have been already alluded to—as, the deprivation of food, or food devoid of nutritive quality; prolonged abode in an impure, unwholesome atmosphere, or in dark and damp situations; chronic diseases affecting the organs of digestion, or those connected with the functions of hematosis, lead ultimately to this state.

In some instances, anemia occurs without the possibility of tracing it to any particular organic cause. The case I published in the American Journal of the Medical Sciences, for May, 1830, was of this kind. The anemic condition had proceeded to great extent, came on gradually while the patient was in full health, was not preceded by losses of any kind from the economy, or by any symptoms indicative of disordered functions.

"The organic or ganglial nerves" (ganglionic system), it is asserted, are the most influential of the causes producing anemia. In the present state of our knowledge, this can be regarded only as an hypothesis. It is impossible to affirm any

thing positively in regard to it. There is too strong a disposition at present to solve all pathological difficulties by a reference to the agency of this class of nervous organs. It is possible the assertion may be true, but the proof is yet wanting.

Hemorrhages frequently recurring from hemorrhoids, from the uterus, bowels, or lungs, I have repeatedly known to bring on anemia. Profuse discharges of secreted fluids may cause it, as in leucorrhœa, serous diarrhœa, and malignant cholera. Imprudent bleeding in those of a highly lymphatic temperament, or where blood is impoverished already from the effects of chronic diseases, is not an unusual cause of the affection.

The above causes are general, and affect the whole mass of the blood; but the organic sanguine fluid of a single organ may be deficient, and thus produce a local anemia. This arises from the irregular distribution of the blood throughout the organism, under particular circumstances. The blood, in its movements through the angeial cellular, or capillary structure, is directed in largest quantities upon the organs the most highly endowed with vital activity and excitement. Where the greatest demand exists, there is the proportionate supply. The derangement of the balance of the forces of the organs is followed immediately by loss of balance in the distribution of the fluids. While congestions and congestive inflammations are thus created in one set of organs, the reverse condition, or anemia and asthenia, prevail in others.

From the views presented, Anemia may be divided into *Complete* and *Incomplete*, *General* and *Local.*

a. *Complete Anemia* is the deficiency of the whole quantity, of all the elements of the blood. This state is a result of excessive hemorrhage—or of hemorrhage recurring so frequently that the reparation of the blood cannot supply its losses. I have met with it also in several cases of dropsy. The effused fluid of ascites has been rapidly thrown off by the kidneys, in one by the stomach, in another by the vagina. Death immediately followed the evacuation of the fluid. On examination, the only appreciable phenomenon was the almost entire absence of blood in all the vessels and organs. A small quantity of fluid blood, thin as claret, and without coagulum, was found in the right cavities of the heart, the cavæ, and liver. The anemia was complete.

b. *Incomplete Anemia* is the deficiency of some of the constituent elements of the blood—the whole mass of fluid continuing undiminished. This form of the disease is far more common than the preceding. The elements most frequently absent are the hematosine, the fibrin, and sometimes the albumen; in malignant cholera, (q. v.) principally the serum. Fibrin and hematosine are closely associated. In what manner, and by what organs, hematosine is formed, and fibrin completed—and how they become united, are yet questions that have not been solved. It is not possible, therefore, to determine the causes that lead to their great diminution in, if not disappearance from, the blood. It is remarkable that in incomplete anemia, the water and serous fluid of the blood, for the most part, increase, as the fibrin and hematosine diminish. The mass or quantity of fluid in the vessels and organs is the same, or even augmented, but it does not possess the characters of healthful blood. In certain dropsies, this state of the blood is the essential character of their pathology; and on which the treatment should be made mainly if not entirely to depend.

c. *General Anemia* accompanies complete anemia. It is the deficiency of the sanguine element throughout the economy. It is equally absent in all the organs—and all are in the same relative condition. It occurs under the circumstances producing complete anemia.

d. *Local* or *Partial Anemia* is the deficiency, in any organ, of the quantity of blood which usually exists in it, and is necessary to the exercise of its functions and healthy condition.

Local or partial anemia may proceed, besides the causes already mentioned, from an accidental or other obliteration of the vessel conveying to an organ its supply of blood. It is seen also occasionally as a secondary result, succeeding to active or chronic inflammation of an organ, by which its structure has been degraded.

The *temperament* possesses an influence in the production of anemia. The one most obnoxious to its occurrence is the lymphatic. In this temperament there exists naturally a deficiency of hematosine and fibrin. Many of the lymphatic temperament are constitutionally anemic. They appear almost destitute of coloured fluid. In such individuals, anemia is developed with great readiness. They are intolerant of depletion from any cause. A single large bleeding, or profuse evacuations of any kind, as menstrual blood, hemorrhages slight in others, excessive purging, or a moderate degree of abstinence, will all induce the symptoms of anemia. The debilitation of patients with the lymphatic endowment, must be cautiously attempted. A rapid and unexpected sinking, with pul-

monary effusion or other fatal complications, often suddenly result from this treatment.

When the lymphatic and nervous temperaments are conjoined, depletion and losses of the fluids are productive of violent commotions in the economy; the anemic condition is complicated with intense nervous disturbance, simulating and often mistaken for inflammatory excitement, cerebral inflammation, dilatation or hypertrophy of the heart, and other serious affections. The error is most grievous. The repetition of depletion to which it may lead, or the persistence in an antiphlogistic and debilitating treatment, will aggravate all the symptoms, and, as I have witnessed, may prove fatal.

The sanguine temperament does not readily admit of anemia. Those who possess it, bear repeated and heavy losses of blood with something of impunity. The reparation of the sanguine fluid with them is rapid. They suffer often a long period under chronic diseases affecting the organs of supply, without manifesting the peculiar symptoms of anemia. Individuals of this temperament rarely become dropsical.

The symptoms proper to anemia are to be distinguished from those that are accidental or belong to the individual, or the other affections with which it may be complicated. This discrimination is too generally neglected in the history of the phenomena of most diseases. It is not all the symptoms presented by an individual who happens to be labouring under a disease that essentially belongs to the affection. Modifications are produced by the temperament, by the habits of the individual, by previous diseases, and by accidental complications of other affections.

The symptoms essentially characteristic of anemia are, 1. A general sense of lassitude, feebleness, and exhaustion—rapidly augmented by exercise or by any exertion. 2. The exterior surface loses its healthful hue and natural colour. It becomes pallid. In the naturally anemic and lymphatic, it is often of a dead and perfect white: in others, especially the mixed and sanguine temperament, the skin possesses a tinge of yellow, that is not unfrequently mistaken for a slight jaundice. On this account the liver is often accused, in this affection, as the subject of disease. It is the bombycinous hue of some of the older writers, resembling strongly the tint of raw silk, or of tarnished white wax. This colour depends on the absence of red colouring matter, permitting the natural hue of the skin and yellowish serous fluid to become obvious through the semi-transparent cuticle. 3. The lips, the tongue, the interior of the mouth, are pallid, or exhibit a feeble yellow colour. The adnata of the eyes are devoid of blood-vessels, and generally of a pure white. The lobes of the ears gradually lose their opacity, and finally assume so much of transparency, it might be suspected the circulation could be seen in their tissues by the aid of a glass. 4. The functions of relation manifest a diminution of their accustomed energy. The intellectual faculties are incapable of continued or powerful effort. The memory is particularly complained of. Patients require the simplest directions and the commonest terms to be committed to writing—as they "can no longer trust their memory." The senses exhibit also in a slight degree less intensity of force. Animal sensibility, on the contrary, is sometimes augmented or irregular, giving rise to neuralgic pains in almost every part of the body. These neuralgic pains, especially when seated in the thoracic or abdominal parietes, or occupying the viscera of those cavities, are very commonly indeed, by those not familiar with their characters, believed to proceed from inflammations. A mistake of this kind, by leading to a treatment the very opposite to that adapted to the disease, it need not be said, has a most detrimental influence. Anemic patients are, for the most part, excessively tormented with head-ache, vertigo, throbbing of the head, ringing and other noises. These are so similar to symptoms of a plethoric and excited state of the brain, that the two conditions have often been, and continue to be, confounded. This error is the more likely to take place, when flushing of the face, redness of the eyes, and heat of the head, accompany the cerebral symptoms of anemia. These last are generally attendant on a paroxysm excited in the anemic patient by some mental exertion, moral emotion, or too active exercise. 5. The functions of the circulation have peculiar phenomena. While the patient remains perfectly quiet, in a state of complete repose, the action of the heart is generally tranquil, regular, and mostly small and feeble. But the lightest excitement, conversation, the presence and examination of the physician, walking across the floor, descending the stairs, any and every exertion, however slight, and moral feeling, however transient, at once throws the heart into a state of commotion: it palpitates, throbs violently and irregularly, beats with a force as though it would burst its bounds. I have heard its sound at

a distance of three or four feet from the patient. The whole arterial system corresponds in its disturbance. The pulse is everywhere throbbing and agitated, generally large. It never feels *tense* and *hard* —more frequently shattered, and empty. The carotids bound in the neck, the jugulars flutter. I have seen the head beat time with the pulsations of the heart. From these combinations of symptoms, simulating so completely diseases of the heart, is it surprising that they should so frequently be mistaken as indicative of those affections? Aware, as I have been for many years, of the close similarity of the disorders of the circulatory functions resulting from anemia, with those depending on organic diseases, I continue to meet with cases, in the highest degree embarrassing. I have known several treated as organic diseases of the heart, by experienced physicians, brought to death's door, by this error. A great responsibility rests on the correct solution of this pathological problem, when presented to the practitioner. It is often decided only by the treatment. The aggravation of the symptoms by depletion, by abstinence, and other means, reducing the amount and enfeebling the force of the circulation, is an indication, if not positive evidence, of the error committed. It is then requisite to pause, to reconsider the history and symptoms of the case, to adopt the very reverse course of proceedings. The amelioration that ensues dissipates all doubts as to the nature of the affection, and a cure is then generally established. In far the larger number of cases, however, an attentive examination of all the attending circumstances, with those that have preceded it, will free the case of its apparent difficulties.

The capillary circulation does not present as decided marks of a deranged condition. It is probably less vigorous and active. This inference may be adopted from the tumidity of the tissues generally, and the constant disposition to œdema that exists in the affection. The anemic patient acquires size, the limbs are fuller, the feet swell, the eye-lids are turgid, the face generally puffy. In this general enlargement, the flesh loses its firmness and cohesion, as it were. Its interstices are filled with serous watery fluid, and it has a soft flabby feeling as well as look. This state of the solids, arising from excess of the serous element of the organic fluid—the blood—is highly characteristic of anemia.

6. The respiratory functions partake of the general disorder. A sense of oppression is not uncommon, even in a state of repose. But when exercise is attempted, the respiration is hurried and laboured, attended with an oppressive sensation of suffocation. The symptoms of anemia manifested in the respiratory functions, as has been seen in the other functions, have a strong resemblance to those proceeding from its opposite condition, or congestion and inflammation.

In natural respiration, a relation exists between the quantity of air inspired into the lungs, and of blood transmitted through them for the purposes of aeration. The loss of this relation on either side is attended with painful or uncomfortable sensations, and disorder in the exercise of the function. Excess in the quantity of blood, or excess in the quantity of air contained in the lungs, is equally distressing to the patient, and productive of symptoms having a striking analogy.

In a death I witnessed, from anemia, being called in at the moment of sinking, the respiration was more painfully laborious, and the sense of suffocation more intense, than I have ever witnessed in any case. Yet the resonance of the chest was perfect, and the respiratory murmur excessive—louder than puerile, in every part of the lungs.

7. Digestion is impaired, and the appetite destroyed. For the accomplishment of digestion, a certain degree of vital activity of the stomach is requisite. Without it, the secretions and temperature necessary for its performance, do not exist, and the process is suspended.

In anemia, especially incomplete anemia, these conditions are wanting, and the function is necessarily imperfect. In chronic diseases tending to the production of anemia, great caution is required on this account, in the resort to depletion. The loss of a few ounces of blood by general bleeding, will immediately produce enfeeblement of the digestive powers, and occasion a rapid deterioration of the organism. I have known a bleeding practised in phthisis pulmonalis, merely because a spoonfull of blood had been coughed up, prostrate the digestion of the patient; and every subsequent meal, for many weeks, was rejected by vomiting. The chronic diseases alluded to, will not suffer this method of treatment. The blood wasted by the nutrition and secretions of the economy, without adequate reparation, must be economized, and the stomach, as the most important of the reparative organs, should be cautiously respected.

The preceding constitute the essential

symptoms proceeding from general anemia. Others are frequently conjoined, either as accidents accompanying it, or as affections that have preceded and been its cause. In the treatment of diseases, it is of the highest importance that this discrimination should always be made. In the sequence of causes and effects that enter into the composition of a disease, the appearance of a new train of phenomena, though proceeding from the antecedent state, demand at once a change in the whole course of proceedings. The same name, it is true, is often retained as designating the disease, yet a totally new condition—another, though consequent disease, has been engrafted on the original, and a modification of treatment, or an entire new method, is indispensable. The introduction of anemia into the order of the symptoms of a disease, is one of those conditions that most imperatively require an especial consideration and an appropriate application of means.

Local anemia rarely occurs except as a consequence of the over-excitement of certain organs, debilitating and exhausting others by the concentration the result of that condition. It is characterized by a paler colour, diminished temperature, contraction or lessened bulk, and suspended function. These last symptoms are then various as are the functions of the organs that may be affected.

Anemia and asthenia of the genital organs (see *Impotency*), of the feet and hands, are frequent, and mostly depend on chronic inflammation of the digestive organs.

The same state of the brain, causing vertigo, and a sudden fall from loss of muscular power (see *Vertigo*), and which had been mistaken and treated for apoplectic fullness or congestion, I have met with in two instances. The attack was preceded by nausea. Both have been relieved by diffusible stimulants, tonics, and good diet.

The indications for the *treatment* of anemia are plain and simple. They are to renew the blood when deficient in quantity, and to renovate it when defective in quality. The methods of treatment for the accomplishment of these objects, will be various. They will depend on the nature of each particular case, the species or variety of anemia, the causes that may have induced, and the affections that have preceded or continue to complicate it. Each will require an especial and appropriate plan of proceedings.

In simple and complete anemia, or mere deficiency of blood proceeding from copious and repeated hemorrhages, as hemorrhoids, menorrhagia, and others, with integrity of the digestive organs, the hemorrhage, the cause of the anemic condition, must be controlled in the first instance. The patient is then to be placed on an invigorating regimen, with highly nutritive and easily digested food. In a few weeks, nature accomplishes a perfect restoration. Three years past, a patient called on me, from the country. He was of robust frame, and had been endowed with great vigour, but was reduced to a wretched condition, pallid, enfeebled, exhausted. Walking a few hundred yards would cause violent palpitations of the heart, hurried and laboured respiration, with various cerebral disorders. These symptoms were produced by daily losses of blood from hemorrhoidal tumours. They were extirpated by an expert surgeon; he was placed on the regimen indicated, with mild tonics, and returned home in a few weeks, relieved of all the troublesome cardiac, respiratory, and cerebral symptoms that had disabled him from the pursuits of life. He is now in the enjoyment of robust health, possesses a florid complexion, and is a fine specimen of the sanguine temperament.

Incomplete anemia presents chiefly an absence or deficiency of the globules and colouring matter of the blood. The restitution from this condition is often accomplished with facility, when it is not depending on disorganizations of important viscera. In this last case, it is hopeless and irremediable. When it results from a defect in the functional, especially the nutritive actions of the economy, as it appears to be when it comes on without assignable cause, or succeeding to intermittent and other fevers, treated injudiciously, it is in most instances completely under the control of the tonic medication and analeptic or invigorating regimen. The tonics that meet this case with most decided advantage are the metallic tonics, particularly the ferruginous preparations. Of these, the phosphate of iron, and the ioduret of iron, are the most efficient. The first is to be given in doses of from gr. ii. to gr. v., three or four times daily; the last is administered in doses of from gtt. iii. to gtt. x. of the solution, three times in the day. They may be either employed exclusively, or both administered in alternate doses, or on alternate days. I have frequently associated with them the sulphate of quinia. With this treatment, cases of alarming aspect will assume, in a short time, an entirely different character, and symptoms apparently of the most danger-

ous import, will be speedily dissipated. The following case is an illustration. Miss W., a young lady of an interior county of this State, had an attack of bilious fever, in the summer. It was treated as those cases so commonly are, by bleeding, purging, salivation. She escaped death, but did not recover her health. During the succeeding winter, she had repeated attacks of chills and fevers, and in the spring, her constitution and health were completely broken up. From the symptoms, it was now suspected she laboured under hydrothorax. She was then brought to the city, and placed under my charge. At this time, the difficulty of breathing had increased to so great a degree, that she was confined to her room. The least exercise would cause violent palpitation, a hurried, laboured, and distressed respiration. Her skin was waxen, lips and interior of mouth colourless, the eye-lids and whole face swollen, lobes of the ears semi-transparent. She was directed to live on the most nourishing soups and delicate viands. Old brown stout and a glass of good wine were drunk daily. She took five drops of the solution of ioduret of iron three times in the day, alternating it with the following powder: Phosph. Ferri, gr. ii.; Sulph. Quiniæ, gr. $\frac{1}{4}$. In a week, an amelioration had taken place; in two weeks, she was able to ride about the city and exercise without suffering; in six weeks she returned home, with her former bloom of health on her cheeks; and within a few days past, after the lapse of two years, I have heard that her restoration remains complete.

In some instances, the irritability of the nervous system is so morbidly developed, that the ordinary doses of the tonics recommended cannot be borne. It is, then, necessary to reduce them to doses exceedingly minute. I have been compelled to resort to doses so small, that to those unaccustomed to their action in the highly irritable condition of the organs, it will scarcely be credited, that they could prove of utility. The following case is in illustration. Miss T., while at school, 17 years of age, had an attack of fever. It was treated in the ordinary mode. She has never known health from that period, and has now been seventeen years almost constantly under medical treatment. From her complexion, the liver, as usual, has been accused of the mischief, and mercurials chiefly relied on. In February last, she came under my care, for hemiphlegia of the left side. Repeated attacks of this affection have taken place, and have been brought on, as in the present instance, by over-fatigue, sudden moral impressions, or any strong excitement. They are always preceded by severe head-ache. This attack yielded in a few days to revulsives along the spine. The case exhibited the characters of anemia, to which I referred the production of the symptoms, and proposed the employment of tonics. This was objected to, as they had been repeatedly tried for intermittent paroxysms, which recur every few weeks, but had always produced alarming cerebral affections. Quinine, in its ordinary dose, acted more as a poison than medicine. It was administered in feeble doses, (a solution of five grains to two ounces of water; dose ten drops,) alternated with the solution of ioduret of iron. In the course of three or four weeks, an obvious amendment had taken place. The intermittent paroxysms were controlled, the anemic symptoms diminished, the forces augmented. The dose was increased, and the solution changed to the following powders: ℞. Sulphat Quiniæ, gr. $\frac{1}{8}$; Sulphat. Zinc, gr. ss.; Phosph. Ferri, gr. i. —three daily. By this method of proceeding, graduating the dose to the intensity of the nervous irritability, the medicine was borne without inconvenience. This patient was entirely recovered after a treatment of three months, directed for the anemic symptoms, and calculated for the renovation of the blood.

The form of anemia depending on loss of the serous or aqueous element of the blood, as in cholera maligna, and serous diarrhœa, requires first that the losses by the profuse evacuations be arrested as speedily as possible; and various, and even opposite means, will accomplish this object: and secondly, to restore the wasted fluids by the constant ingestion of drinks adapted to the state of the stomach.

When anemia becomes a complication superadded to other affections, an epiphenomenon, as it was formerly expressed, the treatment of the original disease must be modified by this circumstance. Should chronic inflammations persist, they must be attacked by revulsives and alteratives. Depletion and debilitation are no longer applicable. In ulcerations and other disorganizations of the structure, the occurrence of anemia is usual in the progress of the disease. This state of the blood is incompatible with the institution of healthful action in the diseased structure, and attempts are to be made for the restoration of this fluid, as far as practicable, to its normal condition. The treatment above indicated is to be adopted so far as it may

accord with the original affection. It is from its action, in this manner, that phosphate of iron, most probably, obtained its repute as a remedy in cancers. The following observations demonstrate the influence of anemia in maintaining morbid action and aggravating the symptoms of disease. They demonstrate, also, the importance of removing this complication before a restorative process can be set up in the diseased organs, or the symptoms removed. Mr. P., of Virginia, received an injury in the right side. It was followed some time after with acute inflammation of the right lung. The lancet and calomel were relied on, and both freely employed. He was bled repeatedly and profusely, until the blood scarcely tinged the linen on which it dropped. He was of the lymphatic temperament. Though completely prostrated, the symptoms had not abated. The cough, pain, frequent pulse and expectoration, continued. A consultation was held, and a persistence in the same course recommended—that is, bleed to reduce the pulse, and then purge violently with calomel. In this state, he came to Philadelphia. He was completely anemic. His skin of waxen aspect—universal serous infiltration—dyspnœa and palpitations on exercise. He was unable to leave his room. The right lung was extensively diseased. No resonance on that side; vesicular respiration defective; pectoriloquy and cavernous respiration in the apex of the lung announced the existence of an excavation in a mass of tubercular degeneration of structure. From the anemic state, immediate danger existed of a sudden termination of the case by a drowning of the lungs from serous effusion into their cells or into the pleuræ. The treatment was directed to relieve this new condition engrafted on the original disease. An analeptic regimen,—strong broths and animal food, with malt drinks, were ordered, with the chalybeate tonics. Having come merely for consultation, he returned home at the expiration of a week. Under this treatment, the amendment was rapid, and inspired his friends and himself with a conviction of a permanent restoration. Two months subsequently, he returned to the city, with his usual strength and general appearance of health. He now commenced a treatment for phthisis. The symptoms abated to such an extent as led me to anticipate an arrest of the disease. But circumstances prevented him from continuing in the city, and on his return home he had not the fortitude and patience to persist for months in a course at once painful and demanding privations. It was abandoned. During the winter, the disease made new progress, and in the spring, I saw him with the symptoms of phthisis indicating an advanced stage. In this case, the anemic state induced by the treatment, prevented the constitutional powers from exercising their agency in the arrest of the diseased organ. Its removal produced a decided and flattering amelioration—placed the patient in a curable position—and his life in his own hands. The following is instructive on the same point. An esteemed friend, Dr. D., accompanied to the West Indies, in the winter, a patient affected with phthisis. While abroad, he was attacked with pneumonic inflammation of the left lung. A French physician, who was called, refused to bleed him in the acute stage. The disease became chronic. Absolute diet was the principal remedy. He arrived in the spring, and remained one day in Philadelphia. I found disease still existing in the lung, with regular hectic. Local depletion, blistering, and diet, with digitalis, were recommended. For a time, an improvement took place, but suddenly the favourable signs gave way. Prostration ensued, palpitations and dyspnœa immediately occurred from light exercise, mental or other excitements; he had profuse night sweats; pulse passing rapidly from 80 to 120 beats. Complexion anemic. He returned to this city on a short visit. The treatment was abandoned; that for anemia substituted. An improvement followed from that moment, and convalescence was established.

Many other cases might be adduced in illustration of this condition of the economy. Anemia, in some of its forms, is a state of the organism I frequently meet with, demanding an especial consideration and method of proceeding. In a mechanism of intricate composition, like the animal economy, and with phenomena so numerous and complicated as those of vitality, combinations almost infinite, new and unexpected developments, must necessarily occur, must be watched for and calculated on by the practitioner, in all prolonged or severe cases of disease. Modifications in the characters and properties of the organic fluids are natural and necessary results of the suspension or vitiation of the functions of the organs; and of these modifications, anemia and its effects are constant in occurrence, though too much overlooked, and demand the attention of the physician.

S. Jackson.

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I. H.

ANEMONE. (*Botany.*)

Sex. Syst. Polyandria polygynia. *Nat. Ord.* Ranunculaceæ.

Gen. Ch. Involucrum remote from the flower, of three divided leaves. *Calyx* petaloid with 5-15 sepals. *Petals* none.—Beck.

It is highly probable that all the species of this genus are endowed with the acrid properties so peculiarly the characteristic of the natural order to which they belong. Only a few of them, however, have attracted the attention of the profession, and been recognized as medicinal.

The *A. nemorosa* of Europe, which is replaced in the United States by the *A. quinquefolia*, a closely allied species, or perhaps only a variety, was at one time extensively used as a rubefacient and epispastic, and is highly recommended by Chomel (*Pl. Usuelles*, II. 376.) as an application in tinea capitis.

The *A. pulsatilla*, *A. patens*, and *A. pratensis*, all European species, resembling each other so nearly that they are constantly confounded by writers, appear to be identical in their remedial effects. Storck, who gave an extended trial to the latter, in a variety of diseases, speaks of it in high terms in the cutaneous affections. He used the extract in doses of two or three grains per diem, gradually augmenting the dose to a scruple. Its efficacy in these complaints is confirmed by Bonnet; and Gmelin states that in Siberia the juice of the *A. pulsatilla* is injected into the ear in deafness.

Dr. J. de Ramon has used the extract of the *A. pratensis*, in small doses, in whooping-cough, with unequivocal benefit. (*Arch. Gén. de Méd.* XVI. 607.)

The *A. ludoviciana*, which closely resembles these foreign species, will probably be found to possess analogous properties.

R. E. Griffith.

ANENCEPHALUS. (From α, privative, and εγχεφαλος, brain.) A term employed to designate those monsters in which the brain is partially or completely absent, with a corresponding defect of the parts by which it is protected. In Acephalous monsters, there is an entire absence of the head; but in those denominated Anencephalous, the defect is less considerable, as the face, a considerable part of the cranium, and in some instances even a portion of the brain and its appendages, exist. The two conditions, therefore, merely differ in degree.

It should be remarked, however, that the term does not accurately express the condition, since there are many cases in which a considerable portion of the brain is developed, and only a limited defect exists in the cranial bones; and where the latter are not very conspicuously evolved, they always exist in a rudimentary condition. In consequence of this ambiguity of the expression, various other terms have been proposed by pathologists; as *anencephalus*, *hemicephalus*, *acrania*, *acephalia spuria*, &c., which are liable to the

same objections. Nor is the term microcephalus, proposed by Malacarne, more appropriate, as it merely has reference to the smallness of the head.

Geoffroy St. Hilaire has proposed a classification of anencephalous monsters, founded for the most part upon the condition of the different parts of the head and its external configuration. He has formed five varieties upon these principles, which are enumerated and defined as follows:

1. Anencephalus. (*Head without brain.*) Brain and spinal marrow both absent; the face and all the organs of sense in their natural state; the cranium open upon the median line, and composed of two lateral halves inflected outwards, and separated from each other.

2. Cystencephalus. (*Head with the brain vesicular.*) The brain restrained in its development; the hemispheres representing a vesicle, mamillary above; the organs of sense, and the cavities containing them, as in the preceding variety; the cranium open above, but the occipital alæ less extensive and less removed from each other; the cervical vertebra most commonly tubular.

3. Derencephalus. (*Head with the brain lodged in the neck.*) Brain very small, reposing upon the occipital bone and the cervical vertebra; the latter generally cleft posteriorly, and enlarged by a spina bifida; the organs of sense and the parts of the cranium as in the cystencephalus.

4. Podencephalus. (*Head with the brain mounted upon a peduncle.*) Brain of the natural size, but placed exterior to the cranium, and mounted on a peduncle, which traverses the opening in the summit of the cranium; the organs of sense and their osseous covering in their normal state; the walls of the cranium composed of pieces of thick, compact, ivory-like bone, closely grouped together.

5. Notencephalus. (*Head with the brain reposing upon the back.*) Brain of the ordinary size, mostly placed exterior to the cavity of the cranium, forming a kind of hernial protrusion through the occipital region and the foramen magnum, partly invested by the common integuments, and reposing upon the back, without contracting any adhesions with it; the parietal regions of the cranium wide and depressed, and the walls of the cranium composed of thin and fragile pieces of bone. (*Philosophie Anatomique; monstruosités humaines*, p. 88. Paris, 1822.)

This arrangement, it will be seen, has no other foundation or utility than that of representing the different degrees of the anencephalous condition, and the relative evolution of the different parts involved in the pathological state. The several divisions do not exhibit species which are fundamentally distinct, but merely shades in the degree of defect; for, as we shall have occasion to demonstrate in the course of our observations, they are all referrible to the same laws, and must be explained upon the same principles.

§ 1. *Condition of the constituent parts of the head in anencephalous monsters.* It will be conceived from the foregoing remarks, that as there are different degrees of defect, as well in the brain as in the other constituents of the cephalic extremity of the trunk of the body, there must also be important varieties in the form, volume, arrangement, and configuration of all the parts of which the head is composed. We propose, therefore, to present a brief summary of these peculiarities, drawn from the examination of such cases as have been reported.

a. *Condition of the brain, spinal marrow, and nerves.* In that variety of anencephalous monsters in which the defect is most considerable, there is a total absence of both brain and spinal marrow: the peripheral portion of the nervous system exists, and is well formed; but the nervous centre, or the cerebro-spinal axis, is altogether defective. This is by far the rarest form of this species of abnormal deviation, and is the only one to which the term anencephalous can be appropriately applied. So seldom, indeed, does it occur, that only a few cases are to be found on record.

Morgagni has reported the case of a female anencephalous monster, in which the cerebrum, cerebellum, and medulla spinalis, were absent. (*De sed. et caus. morb.* Epist. 48. No. 50.) A similar case was observed by Vanhorne. There was no trace of either brain or spinal marrow, and the deformed bones of the cranium were so thick and closely grouped together, that no cavity existed. (Wepfer, *Miscell. Curios.* Dec. 1. 3 obs. 129.) In an anencephalous monster described by Kyavalle, the situation of the brain and spinal chord was merely occupied by a kind of mucus. (*Journ. de Méd.* XXXIII. 151.) Other examples of a similar character have been reported by Fauvel (*Hist. de l'Acad. R. des Sc.* 1711.), Sue (Ibid. 1746.), Littre (Ibid. 1701.), Mery (Ibid. 1712.), Anselin (*Jour. de Méd.* XXXV. 336.), Saxtorph (*Gesammt. Schrift.* Kopenh. 1803. I. 477.), and several others. A very interesting case of the same nature has been published more recently by

Lallemand. The subject was a male, presenting every appearance of a well-nourished child, but the sole semblance of a nervous centre consisted in a few isolated fragments of brain, having neither connexion with each other nor with the nerves. (*Observat. Path. propres à éclairer plusieurs points de Physiologie.* Paris, 1825.) In several of these instances, however, although the cerebro-spinal axis was defective, the membranes and other appendages had attained considerable development. Littre remarks that in the case observed by him, both the membranes of the brain and spinal marrow extended throughout, but were perfectly empty.

The next degree of deficiency is that in which the brain alone is absent, the spinal marrow being more or less perfectly formed. Several modifications of the membranous envelopes of the organs may coexist with this condition. They may either exist in a mere rudimentary state; or, more perfectly evolved, they may form a kind of cyst of variable magnitude, filled with a serous or gelatinous fluid. Where the defect is greatest, the cranial bones are merely in a deformed and imperfect state, and the dura mater forms a kind of excrescence, or irregular mass, adhering to the surface of the bones, and communicating with the spinal canal. Penada found the upper part of the cranial bones elevated about two or three lines only above the base of the skull, and the intervening space occupied by a dense, compact, fibrous substance, formed by the dura mater. (*Saggio di osservaz.* &c. I. Padova, 1795.) Klein also reports an example, in which the brain was absent; and one has been described by Bussiere (*Eph. de N. Curios.* Dec. I. a. 3. p. 324.), in which the carotid and vertebral arteries distributed their small ramifications into a thin membrane, which adhered to the surface of the bones. Meckel, in one case, found the base of the cranium covered with a kind of periosteum only, there being no vestige of brain; and in an example described by Portal, the base of the cranium was covered by the dura mater. Reposing upon the upper surface of the basilar process of the occipital bone, and a little in front of the foramen magnum, there was a small projecting body, about the size of a grain of maize, which collapsed when it was laid open with the knife, and merely discharged a small quantity of blood. (*Annales des Sc. Nat.* XIII. 237. Paris, 1828.) Sometimes the traces of the membranes occupying the part of the deformed cranium which corresponds with its base, are arranged in bands intersecting or interlacing with each other, and filling up what little excavation may exist. This arrangement is usually observed upon the surface of the basilar process, and in front of the foramen magnum; for the spinal marrow generally terminates in such cases below the level of that bone, and the membranes above that point present merely an imperfect rudimentary condition, often so confounded with each other, that they cannot be separated. Nevertheless, in some cases, where the cranial bones are more fully evolved, the vestiges of the dura mater, and occasionally of the arachnoid membrane, may be seen spread out upon the surface of the sphenoid bone, either adhering uniformly to its surface, arranged into bands or irregular folds, or forming a prominent uneven spongy mass, frequently of a red colour, and apparently homogeneous in its structure, but exhibiting no vestiges of cerebral substance. The red colour, however, is seldom manifest except at the point at which the dura mater terminates in the spongy and red-coloured integuments, which correspond to the point where the cranial bones are open above. In a case described by Meckel (*Anat. Physiolog. Beobachtungen*, p. 94. Halle, 1822.), a small tumour hung pendulous from the opening of the cranium, which was covered with a transparent compact membrane continuous with the common integuments. Beneath this, there was a second membrane of nearly the same thickness, but of a more delicate structure, which was reflected over the whole surface of the soft cellulo-vascular substance of the tumour, and adhered internally with its substance. The tumour itself, which was probably the rudiment of the brain, formed an irregular cavity, the walls of which were three or four lines thick. From its inner surface there were several elevations, some smooth, others rough, uneven, lacerated, and pulpy. The cavity was subdivided by a number of vascular bands into others of less magnitude. The lower end of this mass was attached to the spinal marrow. The same author has described several other cases, in which the imperfect cranial cavity was merely occupied by a kind of cellulo-fibrous mass, or excrescence, of a few lines in extent, somewhat spongy in its arrangement, and adherent to the surface of the bones. These structures surmounted the blunt extremity of the spinal marrow, which terminated lower down, and had the delicate radicles of the nerves implanted upon their substance. (*Handbuch der Path. Anat.* II.

196. Halle, 1812. *Descriptio Monst. Nonnullorum*, &c. 4to. Berlin, 1826.) Many other examples of nearly the same nature have been reported by various authors, which need not be referred to, as they merely illustrate the same principles. In all cases, where the defect is so considerable, it would seem that an arrest of development had taken place while the rudiments of the brain and its appendages were yet in an imperfect membranous condition, before the latter had assumed their proper type, and while the bones merely presented irregular fragments or nuclei but little advanced in their process of evolution. This degree of monstrosity, it will be seen, corresponds to that form which Geoffroy St. Hilaire has denominated *Anencephalus proper*.

In the next variety, or *Cystencephalus*, the evolution is further advanced, and although the proper medullary substance of the brain does not exist, the membranes are more or less perfectly evolved, and the place of that organ is supplied by one or more watery cysts or vesicles.

This form of monstrosity is of more frequent occurrence than the preceding, and presents itself in various degrees, from one or more minute formless vesicles, grouped together in the base of the cranium, to a large watery pouch, representing more accurately the primitive type of the brain.

In a case reported by Harder (*Eph. d. n. curios.* Dec. I. a 3. p. 324.), the place of the brain was occupied by a fleshy mass of a darkish red colour externally, and compact within. From its surface, four or five glandular-like bodies projected, which, although altogether unlike the convolutions of the greater or lesser brain, were covered by a strong membrane; they were occupied at some points by cysts containing a yellowish-coloured fluid. The soft and delicate roots of the nerves were attached to the base of this mass, and to the spinal marrow, with which it was continuous below. Monton (*Jour. des Savans.* 1722.) found the base of the cranium occupied by a round, reddish-coloured spongy sack, formed by the dura mater, and filled by a fluid. Haller (*De monst. op. min.*) and Stalpart Van der Wiel (*Cent. Obs. posterior obs.* 2.) observed a similar fungous mass reposing upon the base of the cranium, and occupied by vesicles filled with a thin fluid. Wepfer also describes a case in which there was a convex convoluted reddish-coloured fleshy mass, similar in its configuration to the naked brain. On removing a thin membrane from the surface, a cluster of vesicles adhering to each other by delicate filaments, and filled with a transparent fluid, was exposed. Towards the base of the brain, and in the vicinity of the sella turcica, there was a superficial excavation containing three rounded bodies of a grayish colour, but without either cavity or convolutions, from which the nerves took their origin. In a case reported by Klein (*Spec. Inaug. Anat. hist. monst. descr.* Stuttg. 1795. p. 12.), the situation of the brain was occupied by a mass of vesicles divided into two hemispheres, which adhered to each other, and to the inner surface of the dura mater. The smallest were not larger than a pin's head; the largest about the size of a hazel-nut. They were all filled with a transparent fluid, and furnished with a thick elastic covering. Below them, there was a small mass of cerebral substance observed, extending backwards towards the medulla oblongata and the pons varolii, having a small cavity within, occupied by a delicate vascular plexus. The spinal nerves were all wanting, but the anterior branches of the fifth pair were unusually large. The optic nerves took their origin directly from the brain, without being connected with any manifest elevation existing at the point, and although they approached each other in their course, they did not unite. Rossi (*Mem. di Turin.* VI. 1800.) found the base of the cranium occupied by a reddish-coloured substance, adhering intimately to the bones. It divided into two folds, and behind the orbits, and in a posterior appendage, there were a number of small grayish-coloured miliary granules. The spinal marrow was likewise of a gray colour, but the nervous radicles were destitute of pulp. The internal carotid artery was remarkably small, and the vertebral arteries and veins were wanting. Morgagni also has described two cases, in which vesicular cysts occupied the place of the brain. In the first (*De sed. et caus. morb.* Ep. 48. No. 50.), a vesicle filled with a yellowish fluid was situated upon the anterior part of the base of the brain; and further backwards, entirely unconnected with the cyst, there was a small body, about the size of an almond, which was probably the rudiment of the cerebellum, as it was of a medullary structure, and was placed in the immediate vicinity of the medulla oblongata. In the other case, he saw, covered by a thin membrane, instead of the brain and medulla oblongata, two prolongations extending forwards upon the base of the cranium, and filled with fluid blood intermixed with mucus. Besides these, numerous other ex-

amples, presenting similar conditions, have been reported by Prochaska, Caldani, Dolignon, Romberg, Meckel, and others. However variable the disposition of the parts, it will be seen from the foregoing remarks, that there is but a slight difference in their fundamental conditions. In most of the cases to which we have referred, the spinal marrow either terminated below the level of the cranium, or at the medulla oblongata, lower down than the point at which the cerebellum and cerebrum become engrafted upon it; and although the nerves were seen taking their origin as usual, the only representation of the brain was an arrangement of watery cysts grouped together and covered by the blighted meninges. The state of these membranes, however, shows, that in this grade of monstrosity, the process of evolution had advanced further before its acts became arrested, than in the grade described above. Still, it had not reached that point at which the cerebrum and cerebellum assume their proper medullary character, but was interrupted while these parts were in the fluid state which represents their primitive condition.

When the acts of the formative powers are interrupted at a still later period, the evolution of the parts which constitute the brain will be found more advanced. Here we shall not only find the medulla spinalis and medulla oblongata, but likewise some part of the cerebrum or cerebellum, together with their appropriate membranous coverings. In such cases, however, we shall be obliged to consider not only the degree of development and the condition of the parts evolved, but likewise their situation and relations, as regards the structures which in the natural state are destined to contain them. Thus, only a part of the cerebrum or cerebellum may be developed, the other portions of the organ being deficient or merely represented by membranous cysts filled with fluid; or the whole of the brain may be more or less perfectly evolved, but the parietes of the cranium being deficient, a part or the whole of it may be situated exterior to its proper cavity, as in the three last divisions of Geoffroy St. Hilaire.

Anencephalous monsters presenting some of these characters, are by far more frequently observed than those in which the evolution is more imperfect. In an eight months anencephalous fœtus observed by Marrigues, the place of the brain was occupied by a fungous, reddish-coloured, highly vascular mass, covered by a delicate membrane which adhered closely to its substance. On each side, in the temporal region of the cranium, small masses of cerebral substance were observed, in which both gray and medullary matter could be distinguished. The olfactory, optic and fifth pairs of nerves could be distinctly seen taking their origin from these fragments. (*Jour. de Méd.* XXXIV. 57.) In the case reported by Penchienati (*Mem. di Turin.* IV. 118.), the process of development had advanced still farther, and the monster, which was of the female sex, lived three days, and manifested considerable corporeal energy. The deformed brain and its appendages formed a large reddish-coloured mass, somewhat narrower and thinner before than behind, the contour of which was terminated by the adjacent skin. Within this tumour were the striated bodies and optic couches, the lateral and third ventricles very much enlarged, the quadrigeminal bodies, and the pineal gland. The cerebellum was much softer in its texture, and covered by a thin membrane. The frontal and occipital arteries were preternaturally large, but the temporal arteries were entirely absent.

In this case, as in many others which have been recorded, the brain and its appendages, though imperfectly evolved, could not be contained within the limited and irregular cavity formed by the distorted cranial bones. Under such circumstances, the encephalic mass, presenting a great diversity of form, is protruded through the opening left between the bones of the vault of the cranium; or, if there should be at the same time a spina bifida of the cervical vertebra, it may protrude in part through that opening, while the other part is lodged, as it were, in the upper portion of the spinal canal. When the opening is confined to the upper part of the cranium, or, as is most frequently the case, arises from a deficient evolution of the squamous portion of the occipital bone, one part of the organ is lodged within, while the other, situated externally, is surmounted upon the first by means of a kind of peduncle. This is what takes place in the variety of monstrosity denominated by Geoffroy St. Hilaire, *podencephalus.* The protruded portion in such cases is generally somewhat expanded like the umbel of a mushroom. Examples of this kind are of frequent occurrence, and several have been reported by different individuals. The characters of such monsters have been well described and figured by Geoffroy St. Hilaire. (*Philosophie Anatomique*, p. 448. pl. 6. Paris, 1822.) We have one before us, of a very interesting

character, for which we are indebted to the kindness of our young friend, Dr. JOHN LEE WEBSTER, of Baltimore. The subject is a black child, which lived about a fortnight. The tumour, about as large as an orange, which protrudes through an opening in the occipital bone, is round and nearly uniform upon the surface, and is covered by the skin destitute of hair, beneath which the proper membranes are seen investing its entire circumference. All the other parts of the head are covered with strong hair. One of the cases described by MALACARNE was of this character. A small rounded tumour protruded in the vicinity of the posterior fontanelle, composed, for the most part, of cortical substance, within which the medullary portion forming the arbor vitæ was visible. (*Mem. della Società Ital.* XII. 164.)

More frequently, the defect of the cranial bones is so great that the tumour is broader and more expanded. It forms a broad irregular mass, situated for the most part exterior to the imperfect cranium, and which descends posteriorly upon the back, between the shoulders. This is the variety denominated *Notencephalus*, by GEOFFROY ST. HILAIRE, and is perhaps of more frequent occurrence than either of the other varieties. Cases of it have been described and figured by MECKEL (*Descriptio Monst. Nonnullor.*), and by GEOFFROY ST. HILAIRE. The museum of the University of Maryland contains several interesting examples; and we have seen one in the possession of our friend and colleague, Professor N. R. SMITH, which is particularly interesting, as the membranes of the protruded brain are directly adherent to the placenta.

When the defect, besides occupying the bones of the cranium, extends to the cervical vertebra, a cavity is sometimes formed in the region of the latter, by the want of juxtaposition and union between the lateral halves of the vertebra, in which a portion of the brain may be lodged, while another portion may protrude through the opening in the cranium. This constitutes the *derencephalus* of GEOFFROY ST. HILAIRE, several examples of which have been described by TYSON, HULL, GEOFFROY ST. HILAIRE, LAMBERT, DUBRUEIL, VINCENT PORTAL, and others. In TYSON'S case (*Philosophical Transactions*, No. 228.), the brain was lodged in the cavity of the cervical vertebra, while the proper situation of the organ was occupied by a small tumour about the size of a walnut, covered with blood. In the case described by HULL (*Mem. of the Society of Manchester.* V. 405. 1802.), the brain was almost perfectly evolved. The occipital bone was wanting, and the vertebral canal, which was imperfect, was open from the upper part of the neck to the sacrum. The spinous processes existed, but were cleft and everted, so as to form a kind of cavity, which was largest in the neck. In the upper part of this cavity, the cerebellum was lodged, while the greater brain descended to the sacrum. Both were covered upon their posterior face, merely by the skin.

When the defect of the cervical vertebra concerned in the development of this variety of anencephalous monsters, is very considerable, the two lateral portions of each bone are considerably removed from each other, so as to leave a large space intervening, in which the brain may be lodged. To understand how this condition is induced, it will only be necessary to remember the law of *excentric development*, established in modern times, and which has been especially illustrated by SERRES. According to this law, each vertebra consists at first of two lateral portions having no connexion with each other, but which, after their evolution has attained a certain point, approximate upon the median line, and become completely fused together. Should anything transpire to interrupt the acts of the formative powers before the development has reached this point, a cleft will exist upon the median line, on each side of which will be ranged, in a regular series of concentric arches, the several demi-vertebra whose evolution has been arrested. This interruption may be occasioned by several causes. Thus, in the variety of monstrosity described by GEOFFROY ST. HILAIRE under the appellation of *derencephalus œsophagicus*, that distinguished naturalist supposes, that during the first periods of utero-gestation, and before the development of the osseous system has taken its proper direction under the control of the *nisus formativus*, the œsophagus may contract adhesions with the posterior region of the body, and a portion of this canal being thus folded or flexed upon itself, presents an obstacle to the deposit of the osseous molecules. The central space being in this manner preoccupied, and the process of ossification advancing from the circumference towards the centre in obedience to the law already adverted to, the bone is necessarily formed upon the side of the obstacle, so that when the ossification of the several pieces has attained that degree of evolution compatible with the condition of the parts, there

is, on each side of the obstacle, a regular series of demi-vertebra, the one placed above the other, the obstacle itself filling up the space between them, whether it be the œsophagus or the brain. (Geoffroy St. Hilaire. *Annales des Sciences Naturelles.* XIII. 247. Paris, 1828. Id. X. 1826.)

These principles are well illustrated by the case described by Hull, referred to above. The spinous processes were more or less fully formed, but they were cleft, one half remaining on each side, while the brain, descending towards the sacrum, occupied the space between them. They also receive confirmation from the cases observed by Tyson, Lallemand, Dubrueil, St. Hilaire, Vincent Portal, and Lambert. In some examples of this species, the defect not only involves the posterior part of the occipital bone, and the corresponding portion of the vertebra, but even the base of the cranium is cleft or bifid, and the brain, lodged in part in the upper portion of the anormal vertebral cavity, protrudes in the direction of the pharynx, as happened in a case observed by Serres.

We have already remarked, that in some anencephalous monsters, the spinal marrow is entirely absent. When present, it has been frequently found imperfectly evolved, especially towards its upper extremity, where its place is sometimes occupied by the same species of cellular or membranous structure which we have seen supplying the place of the brain. In a *podencephalous* monster described by Geoffroy St. Hilaire, no traces of pyramidal or olivar bodies could be discovered, notwithstanding the nerves, which originate in their vicinity, presented their ordinary disposition. In some cases, the spinal marrow is more or less atrophied; and Blandin states (*Dict. de Méd. et de Chir. Prat.* Art. *Anencephalus.* p. 383.) that he saw it in one case covered by a kind of pseudo-membranous investment, which occupied the space between its substance and the arachnoid membrane. In the same subject, the spinal marrow was remarkably soft, and its tissue, which was minutely injected and of a deep red colour, was occupied at intervals with small extravasations of blood. These conditions were most apparent in the vicinity of the head, where the pseudo-membranes, as well as the spinal chord itself, had their place supplied by organized cellular tissue.

The condition of those nerves which arise within the cavity of the cranium is variable. When any portion of the nervous centre exists within the cranium, the extremities of the nerves, corresponding with such portion, generally take their origin from it, as when the parts are well formed. But when the brain, as well as the medulla oblongata, is entirely absent and has its place supplied by membrane or cellular tissue, the radicles of the nerves are found losing themselves in these structures. Exemplifications of this remark are furnished by many of the cases which have been reported above. In Harder's case, the soft and delicate nerves proceeded from the base of the formless vesicular mass which represented the brain; and in the case observed by Wepfer, they were seen taking their origin from the three small grayish-coloured masses which occupied the base of the cranium. In other cases, when even a rudiment of the medulla oblongata existed, it constituted the source from which the nerves had their origin, this only being true, however, for those which belonged properly to the portion of the nervous centre upon which they were implanted.

It has been generally asserted that the central extremities of the nerves of anencephalous monsters are relatively larger than usual, and there are some facts favourable to such an inference. It is far, however, from being constant. In one of the cases reported by Klein, it is stated that the anterior branches of the fifth pair of nerves were unusually large; but in Rossi's case, on the other hand, the extremities of the nerves were entirely destitute of medullary pulp; and in two cases examined by Blandin, they were atrophied, and reduced to their mere neuralemma, which was lost in the mass of cellular tissue formed by the membranes.

b. *Disposition of the blood-vessels in anencephalous monsters.* The condition of the blood-vessels of the head in anencephalous monsters, merits particular attention, inasmuch as it has been supposed by Serres and Geoffroy St. Hilaire, that a close relationship exists between the volume of the internal carotids and the vertebral arteries, and the evolution of the brain. Thus, it has been remarked, that when the brain is imperfectly developed, these vessels are remarkably small, or in some cases do not exist, and that where some parts of that organ are absent, the arterial branches which are in the natural condition of the parts distributed to such portions, are either wanting, or merely consist of a switch of minute ramifications. In the adult, where the cranium and face are nearly equal as regards their develop-

ment, the internal and external carotids differ but little in size; but in the fœtus, where there is a considerable preponderance in behalf of the cranium, the internal carotid is proportionately larger than the external. Just the reverse of this is true in anencephalous monsters. Here the cranium and the parts within it being imperfectly developed, the internal carotid is reduced to one half or one third its natural volume, while the external presents its usual size.

Numerous cases might be cited in exemplification of this remark. Thus, in Rossi's case referred to above, the internal carotid arteries are represented as exceedingly small, and the vertebral arteries and veins to have been absent. In the cases observed by Bussiere, these arteries merely distributed a mesh of minute vessels to the membranous substance which adhered to the base of the cranium; and it is remarked by Blandin, that in one case he saw the internal carotid five times smaller than its natural size, and contrasting remarkably with the external, which had experienced a corresponding augmentation of volume. But whatever the size of these vessels may be, they are always seen branching into the deformed rudiment of the encephalic mass, or the debris of its membranes; sometimes merely in form of minute ramusculi, but occasionally, where the parts are more evolved, presenting branches of greater magnitude. How far this condition of the blood-vessels can be regarded as a cause of the defective development of the organs to which they are distributed, is difficult to decide, and it may admit of a question whether it is not itself a consequence of the operation of the same cause which proves instrumental in the arrest of the evolution of the brain and its appendages.

c. *Modifications of the bones of the cranium and cervical vertebræ.* The modifications of the several bones composing the cranium are not less considerable than those which affect the parts contained within this osseous casement. In general, the several pieces can be easily recognized, presenting their proper relations with each other as regards the order of their contiguity, but, as it were, in their minimum state of evolution, and variously deformed. But as each bone is formed from several points of ossification, which are, during the first periods of the fœtal development, perfectly distinct, when the acts of the formative powers are arrested before these points unite, a piece of bone will be found corresponding to each of these rudiments. Hence, the number of cranial bones will generally be found much greater in an anencephalous monster than in a well-formed fœtus. But by examining the proper relations of all these fragments, and grouping them in the order in which they naturally unite with each other, an accurate representation of the number of the bones composing the cranium is furnished. This subject has been very ably investigated by Geoffroy St. Hilaire (*Philosoph. Anat.* p. 23.), who has been enabled to deduce from it some important inferences relative, not only to the number of the bones belonging to the cranium, but likewise their primitive condition, and the order in which they are formed.

But although all the cranial bones usually exist, they are in most cases very much deformed and modified in their structure. Those which form the vault of the cranium are generally more affected, and less perfectly evolved, than those of the base. The former region is generally open or cleft at some point, forming an opening through which the brain protrudes, or which exposes the membranous or fungus-like protuberance which occupies the place of that organ. This cleft or opening, when it is of limited extent, is generally situated in the occipital region, and but rarely implicates the frontal bone exclusively, which though small and depressed, is usually more perfectly evolved than the other bones of the vault of the cranium. Geoffroy St. Hilaire, however, observed one case in which the opening was formed entirely at the expense of the bone, and we have ourselves examined a similar one belonging to the anatomical museum of the University of Maryland. It is also rare for the cleft to be formed by the parietal bones alone, yet where the defect presents its maximum, the opening frequently extends from the root of the nose to the foramen magnum; the pieces composing the frontal parietal, and the squamous portion of the occipital bones, merely presenting small formless nuclei or fragments, everted from the median line, and embedded in the common integuments. When the defect is less considerable, these masses of bone are more fully developed, but their form is altogether abnormal. They are folded outwards, so as to form a kind of alated arrangement, and in being thus inflexed upon themselves, they are rendered convex internally and concave externally, thus presenting a configuration exactly the reverse of that which they exhibit in their natural state. This deformity also extends to the squamous portion of the

temporal bones, and occasionally even to the greater wings of the sphenoid; but the basilar process of the occipital, and the body of the sphenoid, though often more or less deformed, are less extensively modified than the other cranial bones. They generally present the appearance of being protruded upwards, so as to be rendered more or less convex in that direction; but they are rarely cleft like the bones of the cranium. Serres, nevertheless, has reported a case, in which such a fissure existed at the base of the cranium, so as to allow the brain to protrude towards the pharynx. It has been remarked, moreover, that the structure of the bones is considerably modified. The osseous particles seem to be more intimately grouped together, the osseous tissue is more compact than usual, and frequently is rendered almost as compact as ivory.

The condition of the vertebræ is extremely variable, and is influenced by the magnitude of the deformity, and the direction in which it presents its greatest defect. Spina bifida, it will be seen from the cases reported above, is a frequent concomitant of anencephalia, and may be either confined to the cervical vertebræ, or may extend from the neck to the sacrum. In these cases, the arches of the vertebræ are either entirely defective, or they are cleft upon the median line, and each lateral half is everted laterally. In one of the cases to which we have referred above, the arches and spinous processes were formed, but the latter were cleft, and each half was everted outwards.

Another striking feature of these monstrosities is the imperfect evolution of the bodies of the cervical vertebræ. This condition is almost constant, and imparts a singular aspect to the child. The neck is from this cause so much reduced in length, that there is scarcely any line of demarcation between the head and the trunk; but the chin reposes immediately upon the breast, and the ears upon the shoulders. In nearly all the examples of anencephalous monsters which we have examined, this condition has been more or less manifest, and the same remark has been made by Meckel (*Handbuch der Path. Anat.* II. 230.).

The disposition of the bones composing the neck is extremely variable. In some instances, there is not only imperfect evolution of the several vertebræ, but even an absence of one or more of them, as was observed in one case by Haller, where there were only five cervical vertebræ. (*Discr. fœt. septim sine cerebro in op. min.*) Occasionally, the cleft which occupies the arches extends to the bodies, thus rendering the upper part of the spine bifid. Several cases of this kind have been reported, and two have been observed by Breschet. (*Dict. de Méd.* Art. *Anencephalie.*) Sandifort found the atlas so attenuated, that the dentatus seemed to be directly connected with the occipital bone. The third and fourth vertebræ were also inordinately small, but the others were of their proper size. In many cases, they are all very feebly developed, or at least those which occupy the upper part of the column, and are, besides, completely fused with each other, so as to present no line of separation,—a condition which Meckel has remarked, is the more singular, since it represents the primitive condition of the vertebræ in man and animals, and the permanent type of some of the cartilaginous fishes, in which the vertebral column merely presents a continuous cartilaginous body. In those animals possessing an osseous spinal column, nuclei of ossification are developed, at a subsequent period, which finally form the several vertebræ. In the cetacea, this fusion is permanent. (*Loc. Cit.* p. 251.)

d. *General Conformation of the Body.* In consequence of the extreme shortness of the neck, and the chin reposing upon the sternum, the head is thrown backwards, and the face elevated. The eyes are in nearly all cases remarkably protuberant,—a condition which may arise either from an imperfect development of the bones forming the orbits, or an extraordinary largeness of the ball of the eye. In a case described by Rossi, the eyes were double their natural size, and the optic nerves were large in proportion.

Monsters of the kind under consideration, like those which are acephalous, frequently present defects in other parts besides those above described. Hare lip and cleft palate are very common concomitants: we have seen several examples of this, and a great number have been recorded. Sometimes, there is an opening upon the median line of the thorax or abdomen, and, occasionally, some part of the upper or lower extremities is defective; instances of which have been reported by Hammer, Buttner, Walter, Plazanet, Morgagni, Corvisart, Prochaska, Meckel, and others. One or both eyes are sometimes wanting, and the nose has been observed merely presenting a formless excrescence. The internal organs, likewise, often present deviations of considerable extent from their normal type,

but generally less frequent and palpable than those which take place in acephalous monsters, all, however, important, as furnishing data from which we can draw valuable inferences explanatory of the causes of the monstrosity.

It should be remarked, however, that while in many cases we have these evidences of a defective energy of the formative powers displayed in nearly all parts of the organization, cases of an opposite condition are not unfrequent. While there is a defective evolution of the centres, other portions of the system present evident indications of excessive evolution, the inordinate development of one part compensating, as it were, for the defect of another. Thus, it has been remarked by Meckel, Breschet, and others, that anencephalous monsters are generally remarkable for the quantity of their subcutaneous adipose substance; and this has been very striking in every case we have examined. In a seven months fœtus observed by Zacchias, the extremities were much longer than those of a perfect child of the same age. Caldani found the heart as large as that of a child seven years old, and the fingers and toes developed considerably beyond their proper dimensions. The preternatural size of the eyes observed in Rossi's case has been already adverted to.

To the same cause should be attributed the abundance of hair disseminated upon the surface of the body of such monsters, a circumstance particularly noticed by several writers, and especially by Meckel, who remarks, that the distribution of strong hair over the whole surface of the body, seems to result from the impossibility of its being developed in its proper situation upon the head, the forces by which it is produced forming it in an unnatural situation, by way of compensation. This, however, is not very satisfactory; for Zacchias, Bang, Plater, Denys, and others, have described well-formed children presenting the same condition. Thus, the first of these authors reports a family of four children, who *pilo nigro toto corpore conteguntur, non aliter quàm Hædi coloris nigri; quod mihi in mentim revocat ortum Esau.* (*Quæst. Med. Leg.* Lib. VII. Tit. I. quæst. ix. § 14.) Be this as it may, it is stated by Meckel, that in many of the cases which he had examined, especially those presenting the greatest defect of cutaneous development, nearly the whole body, but more particularly the back, the hips, and upper extremities, were thickly covered with hair of six lines in length.

It was long ago affirmed by Morgagni, Sandifort, and Sœmmering, that a greater number of anencephalous monsters are of the female than of the male sex, and the remark has been made by others since their time. The question cannot be very easily decided, many of those who have reported cases, having omitted all allusions to the sex. A reference, however, to the examples on record, in which the sex has been noted, seems to confirm the correctness of this opinion. With a view of settling this question, Meckel has enumerated ninety-one cases of anencephalous monsters, twenty-two of which were observed by himself, and sixty-nine by other individuals. Of this number, fifty-three were females, and thirty-eight males. (*Handbuch der Path. Anat.* II. 234., and *Descriptio Monst. Nonnullor.* p. 51.)

Various reasons for this difference have been offered. It has been suggested by Georget (*Nouveau Journ. de Méd.* VII. 201. 1820.) that it may be owing to a feebler energy of the formative or organic powers in the female than in the male. A more satisfactory explanation perhaps may be found in the fact established by Sœmmering, Tiedemann, and Meckel,—that the embryo is in all cases primarily of the female sex. (See Art. *Acephalus.*)

e. *Viability of Anencephalous Monsters.* It is interesting to determine the extent to which those functions essential to life are influenced by the conditions presented by anencephalous monsters. This is very different during the period of intra-uterine existence, and after birth. During fœtal life, the new being merely forms an appendage of the mother, and the only acts of its economy are those of nutrition and growth, which are consummated through its connexion, by means of the placenta, with the nutritive life of the mother. It merely vegetates, as it were, like a plant, the radicles of which are represented by the placental portion of the umbilical vein; and as its existence is one of dependence, it is not called upon to exercise any of those important functions of relation, which at a subsequent period are indispensable for its preservation. As, therefore, all these acts can be performed independently of any influence from the cerebro-spinal centre, the defective evolution, or even the entire absence of the brain and spinal marrow, do not interfere materially with the performance of those functions which are necessary for the preservation of the existence of the fœtus in utero. Accordingly, anencephalous monsters generally present the appearance of

being well nourished; they move in the uterus with the same activity as those which are well formed, and while their connexion with the mother is preserved, their manifestations of life seem to be quite as strong as under ordinary circumstances.

After birth, their condition is entirely changed. No longer deriving their nourishment readily prepared from the maternal circulation,—or merely forming a kind of appendage of her organization, they are thrown upon their own resources; their functions of relation are now indispensable to their existence, and as the instruments by which they are executed are either absent, or more or less defective, death necessarily ensues. Accordingly, it has been found, that such monsters generally expire the moment their dependence upon the mother is destroyed, although a few have been known to live a few minutes, hours, or even days. Some, at the moment of delivery, breathe, and even cry, and then expire; while others have the respiratory function so perfectly developed as to live some time, and even take the breast. The latter was observed by Saviard and Hull, and has been remarked by others. In Saviard's case, the infant survived four days, moved freely, and nursed. In that described by Hull, the child took the breast, the eyes manifested their ordinary sensibility to light, and the pupil contracted readily under its influence. Buttner, however, remarks, that in a case observed by him, the eyes could not be opened, and the child, in the act of respiration, was compelled to throw the head forward. In one of Klein's cases, the child, which lived 24 hours, was in a perpetual stupour; the respiration was slow, the pulse imperceptible, the countenance of a bluish cast, and the eye scarcely sensible to light. The same torpidity and slow respiration were also remarked by the same author in another case.

In all these manifestations of life, respiration is an indispensable condition, and of course it can only occur in those cases in which the portion of the medulla oblongata exists from which the pneumogastric nerves derive their origin. Where this is absent, life cannot be sustained even for a few minutes, as the child cannot breathe; but as it is frequently more or less developed, such monsters not unusually present indications of life for some time after birth.

Another circumstance tending to impair the capability of such monsters for the state of independent existence, is, that a large majority are prematurely delivered. Many of them are born at six months, some at seven or eight, and only a few reach the full term of utero-gestation. The principal cause of death, however, is the defect of that portion of the nervous system which presides over respiration, and the consequent incapability of calling that function into action.

f. *Causes of this species of monstrosity.* If we take the opinions which have been maintained upon this subject at nearly all periods of the world, we shall find that they may all be referred to two heads: 1. that the monstrosity is an original condition with the germ itself; and 2. that the brain and its appendages are formed according to their proper type, but are afterwards destroyed by some cause acting upon them, either from within or from without.

The first of these opinions was espoused by Littre, Tyson, Van Dœveren, and Winslow, and has been adopted by Gall and Spurzheim in more modern times. This theory, however, supposes the preexistence of germs,—a doctrine which we believe has few defenders at the present period, and which cannot be maintained.

Those opinions which are referrible to the second head, are more entitled to our confidence. Those who advocate them, however, are divided amongst themselves; for while many of them maintain that the monstrosity is the result of mechanical causes, operating from without inwards, destroying the cranium and brain after they have been formed according to their proper type, others contend successfully, that such causes cannot explain many other defects in anencephalous monsters. Haller, Sandifort, Rossi, and Siebold, have contended that the mischief always proceeds from violence acting from without. Morgagni, Morenheim, Penada, Klein, Chaussier, and Beclard, however, in taking a view somewhat different, have ascribed the destruction of the brain to causes operating from within outwards, and especially to the formation of a large hydrocephalus, which, in finally becoming ruptured, discharges itself into the liquor amnii, and allows the parts to collapse and take on the aspect of deformity which they generally present in anencephalous monsters. Haller adduced in support of the first opinion, the existence of the nerves which take their origin within the cranium, the presence of foramina in the cranial bones for their transmission,—also, the existence of the carotid arteries and the internal jugular veins. Amongst the causes which have been enumerated as

likely to produce this destruction of the brain, are falls, blows, contusions, sudden shocks and commotions of the system; pressure exercised upon the child, either by something appertaining to the mother, by some object foreign to her system, or by a second fœtus, as in twin or triplet cases. A satisfactory refutation of such views is furnished by the frequent coexistence of other vices of conformation, which cannot be referred to the operation of mechanical or physical causes. No influence of this kind could destroy portions of the extremities, produce a cleft palate, spina bifida, diverticulæ of the intestines, and many other conditions of the internal organs, frequently found in anencephalous monsters. The striking analogy, moreover, presented by them all, has been very justly urged by MECKEL against this hypothesis. Many of the vices of conformation of the internal organs are too constant to be the effect of mere accident, and rather tend to show that they result from constant and immutable laws.

The hypothesis which refers the defect to causes exercising their influence from within outwards, and especially the outward pressure of hydrocephalus, though certainly more satisfactory than the opinion we have just noticed, is far from being competent to explain all the phenomena presented by many of the internal and external parts of the body. Repeated observation has satisfactorily demonstrated that even an enormous hydrocephalus may be developed without destroying the brain, this organ being either compressed by the circumambient water, to the bottom of the cranium, or its cavities so distended as to unfold the different convolutions, and convert it into a vast sac composed of medullary and cortical substance, as has been satisfactorily illustrated by GALL and SPURZHEIM.

A much more rational explanation is that which refers the deformity to an arrest of development, taking place at some period previous to the perfect evolution of the encephalic organs. It is possible that the supervention of hydrocephalus, as has been maintained by MECKEL, may sometimes occasion such an interruption; but we are satisfied he has attributed too much importance to it. The same interruption may doubtless proceed from other causes, as, for example, preternatural adhesions contracted between some part of the placenta and the fœtus, as remarked by GEOFFROY ST. HILAIRE; inflammation attacking the encephalic organs during an early period of their development, as represented by BLANDIN; and, as regards the particular organs in question, an imperfect development of the blood-vessels, to which SERRES has attached much importance. To these causes, however, must be added a too feeble energy of the formative powers, rendering them incompetent to accomplish the full and perfect evolution of the whole of the organs. It is a known law of the animal organization, that all its parts are not simultaneously formed and perfected. There is a regular succession in the order of their development, and it may happen, that after some of them have attained their proper form, others, which make their appearance at a later period, may have their evolution arrested, in consequence of the formative powers being too feeble to insure their perfect development. Or, should an arrest take place in the encephalic organs, even before the others have reached their perfect evolution, it will be possible for those which are undisturbed to pass regularly through all the stages of their development, while the encephalic organs alone will be defective. In some instances, moreover, in consequence of the operation of the law of *compensation* (*balancement des organs*, of GEOFFROY ST. HILAIRE), while an arrest of development takes place in the brain and its appendages, some other organ acquires an inordinate evolution, the augmentation of the latter being proportionate to the defect of the former.

From all these considerations, we are constrained to adopt the conclusion, that anencephalous, as well as acephalous monsters, are dependent upon an arrest of development affecting the brain, its osseous coverings, and sometimes likewise its membranes, the spinal marrow, and several other parts of the organization. The two forms of monstrosity merely differ in degree, and owe their development to the same fundamental laws; the greater defects which are manifest in acephalous monsters, and the greater number of vices of conformation, being merely owing to an interruption of development taking place at an earlier period than in anencephalous. The remarks, therefore, which we have made in the article *Acephalus*, will apply equally to the present subject, to which, and to the article *Monstrosities*, we must refer for further illustrations.

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E. GEDDINGS.

ANESTHESIA. (From α, priv., and αισθησις, sensibility.) Diminution or loss of sensibility or feeling, without loss of the powers of motion. (See *Sensations, pathological states of,* and *Paralysis.*)

I. H.

ANETHUM. (*Botany.*)

Sex. Syst. Pentandria Digynia. *Nat. Ord.* Umbelliferæ.

Gen. Ch. *Fruit* nearly ovate, compressed, striated. *Petals* involute, entire. WILLD.

1. *A. Fœniculum,* LINN.—*Meum Fœniculum,* SPRENGEL.—*Fennel.*—*Fenouil,* Fr.; *Fenchel,* Germ.—*Sp. Ch.* "Fruit ovate." WILLD. *Sp. Plant.*—Fennel has a biennial or perennial, tapering root, and an annual, erect, round, striated, smooth, green, branching stem, which rises from three to seven feet in height. The leaves, which stand on membranous striated sheaths, are alternate, three times pinnate or more, with long, linear, pointed, deep green leaflets. The flowers are yellow, and disposed in large many-rayed umbels, without general or partial involucres. The petals are five in number, equal, pointed, and rolled inward at the summit. Each flower is followed by two oblong-ovate seeds, convex with five longitudinal ribs on one side, flat on the other, sometimes slightly curved, and often joined together by the flat surfaces.

There are several varieties of fennel, which, by some botanists, are considered as distinct species of a particular genus, which they denominate *Fœniculum.* The varieties in use are the *common fennel* (*Fœniculum vulgare Germanicum,* C. Bauhin, pin. p. 147.), and the *sweet fennel* (*Fœniculum dulce,* C. Bauhin, ibid.), of which the latter is distinguishable by its longer leaflets and larger seeds.

The plant is said to be originally from the south of Europe, but now grows wild in Germany and England. It is cultivated, for medical use, in the gardens of this country and of Europe. All parts of it have an aromatic odour and taste, dependent on a peculiar volatile oil. The roots were formerly officinal; but they are much weaker than the seeds, which are the only part kept in the shops. (See *Fennel.*)

2. *A. graveolens,* LINN.—*Pastinaca Anethum,* SPRENGEL.—*Dill.*—*Aneth,* Fr.; *Dill,* Germ.—*Sp. Ch.* "Fruit compressed." WILLD. *Sp. Plant.*—Dill is an annual plant, with an erect, striated stem, simple below, branched above, from two to four feet high, and furnished with alternate, bipinnate or tripinnate leaves, which stand on sheathing footstalks, and have linear, pointed leaflets. The flowers are yellow, and in large, flat, terminal umbels without involucres. The plant bears considerable resemblance to fennel, but is smaller, has more expanded umbels, and seeds of a different shape. It is a native of the south of Europe, and is sometimes found growing wild in the more northern latitudes of that continent, where it is also cultivated for the sake of its seeds. It has been introduced into our gardens. The whole herb is aromatic; but the seeds are the most active part. These are officinal in Europe, though little used in this country, and not recognized by the U. S. Pharmacopœia.

Dill seeds (*Anethi Semina,* L. Ph.) are oval or roundish, rather more than a line

in length, slightly convex on one side, flat or concave on the other, of a grayish-brown colour, surrounded by a yellowish membranous border, and marked by three yellowish longitudinal ridges on the convex surface. Their odour, though less agreeable than that of fennel seed, is strong and aromatic, and their taste moderately warm and pungent. These properties depend on a volatile oil, which may be obtained separate by distillation. The virtues of the seeds are extracted by alcohol, and by boiling water.

Dill has the medical properties of the aromatics, but being less agreeable and not more effectual than others of the class, is little used, at least in this country. The leaves may be given in infusion, the seeds in infusion or powder. The dose of the latter is from fifteen grains to a drachm. Water distilled from the seeds is directed by the London College under the name of *Aqua Anethi.* It may be employed for the same purposes as the other aromatic waters.

GEO. B. WOOD.

ANEURISM. Medical etymologists have not determined on the derivation of this word; some, as MONTANUS, deriving it from α, priv., and νευρον, a nerve; others, from ανευρυσμα, "enlargement, dilatation"—as if from ευρυνω, dilato; M. A. SEVERIN, from ευρηνειν, "exilire" seu "effluere."

Whatever derivation may be adopted is of minor importance, for surgeons have generally restricted the word to that form of disease which may be defined—*A sanguineous tumour, communicating by a contracted orifice, with an artery.*

Aneurismal tumours may arise from dilatation—rupture or ulceration of one or all the coats of an artery: they may occur from external or internal causes; in diseased or healthy vessels: their parietes may be formed by the coats of the arteries—by the cellular sheath of these vessels—or by any superjacent tissue, not excepting bone, and occasionally even by the coats of a vein. They are usually, but not always, pulsating swellings—generally marked by definite lines, but not unfrequently greatly diffused. These, and other peculiarities—many of which are of great practical importance—have been made the foundation of numerous divisions of aneurisms, by which the learned, as well as the unlearned, have been confused. Practical utility shall form the basis of the divisions and definitions adopted in this article; but the numerous names bestowed by authors on the varieties of aneurism, must be noticed and defined, for the benefit of the medical inquirer.

From the following investigation, two diseases, usually arranged under aneurisms, will be excluded, as presenting no feature, either in their anatomical or pathological character, allied to a proper aneurism. The first is, *Aneurism of the heart*, so called—which consists in a morbid dilatation of the cavities of this viscus; and the second is, *Aneurism by anastomosis*, or dilatation of capillary vessels, veins, and arteries—with increased pulsation and circulation. The former will be noticed under the head of *Diseases of the Heart*, and the latter, of *Nævi Materni*—of which they are a variety. There are, however, tumours formed in the walls of the heart, which may be termed aneurismal. M. BRESCHET has published a monograph on this subject, detailing ten cases, collected by himself and others, in which sanguineous tumours were detected *post mortem*, containing coagulated blood, and communicating with the ventricles. M. REYNAUD has reported a very interesting case (*Dict. de Méd. et Chirurg. Prat.*), in which two aneurisms existed on the heart. The lining membrane was in a diseased condition, and, at two spots, was dilated into pouches of the size of a nut, containing coagula of blood, and having the orifices of communication with the ventricle, smaller than the bodies of the tumours. The muscular fibres did not form a coat to these swellings, but were pushed to one side, so that the lining membrane of the ventricle became adherent to the serous portion of the pericardium covering its external surface. These sacs were not prominent externally. In the cases cited by BRESCHET, there appeared to be generally a destruction of the internal lining membrane, and the walls of the swelling were formed sometimes by the muscular fibres of the heart, but usually by the adherent and loose portions of the pericardium, united by the adhesive inflammation; the tumours varying in size from that of a small nut, to the fist of a man. M. BRESCHET describes one, of the size of an egg, found on the heart of the celebrated tragedian, Talma.

Of these aneurisms of the heart, there are no characteristic symptoms—so that their existence can only be detected post mortem; and, as their nature and formation are involved in the general doctrines of aneurism, they require no specific consideration.

All sanguineous tumours communicating with an artery, may, for practical purposes, be divided under two general heads—*Spontaneous* and *Traumatic Aneurisms.*

Spontaneous Aneurisms depend on an original diseased condition of the artery, and, at their commencement, are formed by the dilatation of one or more of the coats of the vessel.

Traumatic Aneurisms arise, as the name imports, from a wound, rupture, or ulceration of a healthy vessel; the parietes of the tumour being formed, not by the arterial tunics, but by the cellular sheath of the vessel, or other surrounding tissue.

This includes that variety of aneurism termed *Varicose Aneurism*, in which the tumour is formed in part or entirely by the coats of a vein, as will be hereafter described.

Aneurisms, whether spontaneous or traumatic, may exist internally or externally, as respects the great cavities of the head and trunk, and hence are often termed *internal* and *external*. This division will be retained—being founded not only on the difference of location, but also on the fact, that the treatment of internal aneurisms is, almost exclusively, medical, and that of external aneurisms, surgical. The successful enterprise, however, of modern surgeons, has caused us to regard many aneurisms as external, so far as treatment is concerned, which were formerly termed internal; for example, aneurisms of the external and internal iliacs, of the common iliac, at the root of the common carotids, of the subclavians, and even of the arteria innominata.

There is, however, no essential difference in the pathology of internal and external aneurisms; nor even in the principles of treatment; so that the slight modifications in pathology or practice will be noticed under diseases of individual arteries.

In adopting the two grand divisions of aneurisms, already mentioned, we do not contend for the strict propriety of the names employed, but would use them simply as indicating the fact, that in spontaneous aneurisms there is a prior diseased state of the artery, and in traumatic aneurisms, the artery is supposed to be healthy. In the former, external agents, such as contusions, and violent muscular efforts, have but a secondary influence in the production of the tumour, there being always a morbid condition of the arterial tunics as an essential predisposing cause, and the dilatation often occurring without any external influence. Such aneurisms depend, therefore, on internal or occult causes, and, for this reason, are termed spontaneous,—not as originating *suâ sponte*, or without cause, as this, in science, is an absurdity. In the latter, or *traumatic* aneurisms, a prior healthy condition of the artery is presupposed; nevertheless, a wound may be inflicted on an artery so diseased that an aneurism will result with the peculiarities of spontaneous aneurism, which should therefore be arranged under the first division, respect being had, not to the exciting cause, but to the condition of the artery. On the contrary, it is possible for an aneurism to be formed by the ulceration or sloughing of an artery, otherwise healthy—thus arising, not directly from a wound, yet nevertheless, according to our rule of practical utility, to be regarded as a traumatic aneurism.

The truth and importance of this division will hereafter appear. It differs, in some respects, from the true and false or spurious, aneurism of authors. By a *true aneurism* is usually understood a tumour formed by the dilatation of all the coats of the artery: by a *false aneurism*, where the parietes of the tumour are formed by one or two only of the arterial tunics, or, when there is a solution of continuity in all the coats, by the cellular or surrounding tissues;—the former being termed a *false consecutive aneurism;* the latter, a *false primitive aneurism.* The words—true and false—are thus employed in relation, not to the condition of the vessel, but merely to the coats of the tumour, a circumstance of little practical importance, and continually varying in the progress of the disease, as will be hereafter demonstrated.

We read also of *Mixed Aneurisms*—of external and internal mixed aneurisms. By an *external mixed aneurism* is meant a sanguineous tumour formed by the dilatation of the external or cellular coat of the artery, there being a solution of continuity in the internal and middle coats. An *internal mixed aneurism* is supposed to be formed by a dilatation of the internal coat, the external one being divided or ulcerated; hence, also termed a *hernia of the arteries—aneurisma herniam arteriæ sistens.*

These divisions can be of no utility, as there are no indications of their existence prior to the death of the patient: they can be manifested only by careful and minute dissection—and even then, form sources of disputation even for the most skilful anatomists—who, for example, have not yet determined whether a hernia of the artery—an internal mixed aneurism—has ever existed.

§ I. Spontaneous Aneurisms. These we have defined to be sanguineous tumours, communicating with a diseased artery, and occurring from internal or occult causes.

Symptoms. The first positive indication of the existence of aneurism is the appearance of a pulsating tumour. The patient can usually recollect some prior uneasy sensations in the course of the artery, and that a peculiar sensation had been excited in the part by some unusual effort. Sometimes there are no prior morbid indications, and the tumour may often exist, especially when internal, without the consciousness of the patient.

In the early stage, a small pulsating tumour, of a hemispherical or elliptical form, is observed over the course of a large artery. It is indolent, soft, and circumscribed; the skin retaining its natural colour and properties, without heat, pain, or other inflammatory symptoms. The pulsations are synchronous with those of the artery. Pressure on the aneurism diminishes or totally obliterates (Boyer) the tumour. When removed, its volume is instantly restored, often with a whizzing sound, or with a peculiar thrill (bruissement). Pressure on the artery, above the tumour, weakens or destroys the pulsation, according to its degree, the swelling becoming more soft and flaccid; but pressure on the vessel, below the tumour, renders the aneurism more tense, and augments its pulsations. These pulsations are excentric—the tumour not being raised *en masse*, but dilated at every systole of the heart. The frequency and force of the pulsations, depending on the action of the heart and arteries, are aggravated with every excitement of the general circulation, whether from moral or physical causes. Very little difference exists, at this early stage, in the action of the artery above and below the tumour, and no change can be detected in the collateral and anastomotic circulation.

The aneurism is often stationary—or it increases slowly, so that after many months it is not larger than the fist. (Boyer.) Subsequently, from some sudden exertion, or other exciting cause, the increase is more rapid, the symptoms change, and frequently are less characteristic. The tumour can no longer be dissipated by pressure on its walls or on the artery,—it is often but slightly diminished; it is more firm—often hard and painful; pulsation is less evident, and, in old tumours, is sometimes imperceptible to the touch: by auscultation, a whizzing sound (bruit de soufflet) can usually be detected, but even this is sometimes absent. There are now evidences of impaired or difficult circulation in parts beyond the aneurism, and of diminished nervous influence. If in a limb, the extreme parts are pallid, cold, frequently œdematous. The patient complains of inability to muscular effort, with a sense of numbness and stiffness. Often there are irregular neuralgic aching sensations. The artery, above the aneurism, is apparently enlarged—while below, it seems diminished—the pulse being weak and small. Occasionally, no pulsation can be detected in the main trunk, while the smaller vessels, about the joints especially, are enlarged, and pulsate with great distinctness and force.

Towards the termination of the complaint, the above symptoms become aggravated: there are greater evidences of impaired circulation, such as a varicose condition of the veins, coldness and lividity, or great pallor, increased anasarca, sometimes even gangrene and sphacelus of the extremity. The tumour enlarges rapidly—approaching the surface, and becoming more "pointed:" the pulsations sometimes become more distinct, especially at the more elevated portions: the skin is now adherent and discoloured; at first, it is of a bright colour, with some increased temperature,—but soon it assumes a livid appearance, becomes very thin, and often sphacelates. Sloughing ensues, accompanied by active hemorrhage, sometimes from small fissures—and then temporarily arrested by pressure or the formation of coagula. It soon returns with more frequency and impetus, until the patient sinks exhausted. Not unfrequently, from some muscular exertion, or some sudden excitement, the slough is freely separated, or the sac is ruptured, and a sudden gush of blood terminates the sufferings and life of the patient.

This sloughing and perforation often occurs on mucous surfaces, as, of the trachea, œsophagus, intestines, &c.; but occasionally the opening occurs on serous surfaces, as, of the pericardium, pleura, and even of other large arteries, as of the aorta, or pulmonary artery. In these last, it is said, rupture or ulceration occurs without prior sphacelation.

The symptoms above detailed may be regarded as characteristic of aneurism; but there are numerous secondary affections, arising from the size and pressure of the tumour, and from the disturbance in the functions of important organs, by which the distress and danger are aggravated.

In external aneurisms, the pressure on

the veins, arteries, and absorbents, interferes with the circulation, and nutrition of the limb; and when the skin or fasciæ are rendered tense, gangrene and sphacelus of the limb may result. The nerves are often irritated, causing great pain and cramps towards their sentient extremities; and sometimes they are disorganized,—whence paralysis and increased liability to sphacelus. Muscles and tendons are often rendered tense, or turned from their natural location, so that their powers are impaired, and lameness induced. Ligaments and joints become irritated and inflamed, and the bones even destroyed by caries or necrosis.

Aneurisms within the cranium cause cephalalgia, convulsions, coma, and other cerebral affections: within the thorax, orthopnœa, dyspnœa, lividity of face, congestion of the lungs, violent and irregular action of the heart, and sudden death—in some cases even where the tumour remains entire. Analogous functional disturbances attend the course of this disease, in the abdomen, so that these secondary and accidental symptoms are often the most important and urgent indications of disease and danger, as will more fully appear when individual aneurisms are described.

The *diagnosis*, therefore, of aneurism, is generally very easy; but dangerous and fatal mistakes have been made, as this complaint has been confounded with steatomatous or encysted tumours, abscesses, &c. On some occasions, the diagnosis, however carefully founded on the history of the case and on existing symptoms, is exceedingly difficult; great care, therefore, should always be exercised.

Various tumours situated over a large artery have a pulsating motion, synchronous with the heart; but can usually be distinguished from aneurisms by their hardness, mobility, cessation of pulsation when pushed to one side or when elevated,—by the condition of the artery and of the circulation above and below the tumour,—by the absence of pulsation in the early stage of the affection, and by the progress of the disease. If, also, pressure be made upon the artery, above or below the tumour, no alteration occurs in the appearance of the swelling, unless it be aneurismal; in which case it becomes more flaccid if the pressure is made above, and more tense when made below, the tumour. So, also, says Hodgson, if moderate pressure be made upon the portion of an artery above an aneurism, the blood, entering by a diminished opening, and, of course, in a smaller stream than usual, causes an undulating or thrilling pulsation, instead of the equable pulsation formerly excited: if there be no aneurism, the pulsation of the tumour is still uniform, though less violent than when a full current of blood passed through the artery. Moreover, aneurisms can usually be diminished by regular compression on the tumour and artery, but regain their dimensions immediately on its removal. This diminution may be effected to some extent even in old aneurisms—but not in the case of ordinary tumours.

When the tumour is affixed to a movable tissue, as, a muscle, the larynx, &c., the diagnosis is easier, as they move together, showing no direct connexion with the artery. Thus, a pulsating bronchocele may be detected by its motion with the larynx and trachea.

The distinction is more difficult when the tumour is closely adherent to the artery or its sheath, and especially when confined by broad muscles, fasciæ, &c.; but in all cases, much may be learnt from the history of the complaint. There is another sign of importance,—that these tumours are simply elevated by the pulsation of the artery—while in aneurisms, the influx of blood at every systole of the heart, dilates the tumour in every direction: the motion is not that of simple elevation, but is excentric. This enlargement, however, is in any case very trifling, and in old aneurisms is chiefly observed towards the prominent parts of the swelling; it nevertheless differs from the mere elevation of the tumour, and should always be regarded.

In encysted tumours, more attention to the above signs is required, as their elasticity renders the resemblance to aneurismal swellings more striking. Arteries are frequently surrounded by fluids, collected in their sheath or in the surrounding cellular tissue—such as blood, serum, pus, &c., and communicate many of the signs of aneurism to such collections. The history of the affection, and careful minute examination of existing symptoms, will generally be adequate for the diagnosis. "Thus," says Boyer, II. 109, "the surgeon will inform himself of the manner in which the tumour originated, and of the phenomena presented at its commencement: if he learn that at first it was very small—that it increased gradually, and afterwards, in consequence of some effort, or without any known cause, suddenly enlarged considerably—if it presented pulsations at the time of its formation, which diminished gradually, and finally ceased—

if compression, which at first caused it to disappear, or at least diminished its volume, now effects no change, he can pronounce with certainty that it is an aneurism." In another place, p. 111, he says, that "in suppurating tumours, the fluctuation, beginning at the centre, extends to the circumference—the softened portion being proportioned to the duration of the abscess. Not so in aneurisms of long duration, which become more firm at their circumference. The pulsations of an aneurism are more marked when it is recent and of small size: the pulsations which humoural swellings present, are, on the contrary, stronger and more extended, in proportion to their size, because they press more on the neighbouring vessels, and augment the lateral effort of the blood." If, to these observations be added, that the symptoms in cases of abscesses are relieved by the occurrence of suppuration and fluctuation, an error need seldom be committed. Still, however, the difficulty is sometimes insuperable, especially when there is no pulsation in the tumour, and when all the signs of abscess are present. Sometimes the two complaints unfortunately coexist. De Haen relates "that a man suffered from an erysipelas commencing in the foot and extending to the leg and ham: the engorgement in this last situation did not disappear, and was converted into a tumour, which appeared to pass very slowly into suppuration. Near two years afterwards, fluctuation was evident, and there was not the least pulsation. A small opening was made in the centre of the tumour; some pus was evacuated, but the swelling was but slightly diminished in size, and for some days things remained stationary. Eight days after, there supervened an unexpected and terrible hemorrhage, and the patient died. Dissection proved that an aneurism had existed, the sac of which was surrounded by an abscess." Boyer, II. 110.

If any doubt respecting a swelling remain on the mind of the surgeon, he should not operate, either by puncturing the cyst, or by securing the artery, but resort to palliative measures until the character of the complaint be more decided. When conflicting opinions exist among several surgeons, when the symptoms are urgent, or when patients or their friends are anxious for a decision, the tumour may be punctured with a grooved needle, that a small portion of the contents may be evacuated. Should the tumour be aneurismal, there would be no danger of immediate hemorrhage from the puncture, and, every preparation being previously made, a suitable operation ought to be performed immediately, before inflammation and ulceration of the sac ensue—or before the cellular tissue be injected with blood from the sac; an accident, however, which would not probably occur.

Anatomical Character of Aneurismal Arteries and Tumours. The second series of facts necessary for understanding the nature of spontaneous aneurisms, and establishing the principles of treatment, is derived from *dissection;* by which is revealed the prior condition of the arteries—the condition of the tumour at its various stages from the incipient formation to the period of rupture or of cure—and the changes which ensue in the artery—in the collateral and anastomosing vessels—and finally, in the tissues and organs connected with or depending on the diseased vessel.

Condition of the Arteries. Under another division—the formation of aneurisms—it will be shown that no tumour forms unless prior disease existed in the artery, and it is very rare that an altered appearance cannot be demonstrated post mortem. For the nature and appearances of diseased arteries, reference must be made to another article (*Arteries*); at present it is sufficient to observe, that chronic inflammation appears, from the observation of the latest observers (Hodgson, Guthrie, Begin, Breschet, &c.), to be the original affection, effecting numerous changes in the condition of the vessel, particularly at the situation of the aneurism. Hence, the loss of elasticity in the several coats of the vessel—the preternatural brittleness of the internal and middle coats—the pultaceous or atheromatous—the cartilaginous, scaly, calcareous, or osseous, depositions in the substance of, and under, the internal and middle coats, and the consequent rupture or ulceration of these tissues. Cracks or fissures, and even ulcerations of the lining membrane, are sometimes found when no aneurismal sac has been developed.

The blood, in these cases, sometimes passes into the tissues of the artery, as in ecchymosis, separating the tunics from each other—often for a considerable distance. This ecchymosed condition of the artery has of late received the name of a *dissecting aneurism*, from Laennec, who describes, at length, the symptoms during life, and the appearances post mortem (II. 411, &c. *De l'Auscultation.*), in a case which occurred to his cousin, M. Ambroise Laennec. The arch of the aorta, in this instance, was incrusted with osseous scales,

and dilated so that it could contain a moderate sized apple. The descending aorta, at about two inches from its origin, presented internally a transverse fissure, occupying two-thirds of the circumference, and interesting solely the internal and middle coats. The edges were thin, unequal, and apparently torn in places. The external coat was sound, and separated from the fibrous coat, from the fissure even to the origin of the primitive iliacs, so that, at the first glance, the cavity of the aorta appeared to be divided by a septum. The separation extended some lines on the primitive iliacs, and also on the cœliac artery: above, it ascended even to the curve of the aorta. It formed an oblong sac, filled with coagula of blood and polypiform fibrinous concretions. At one extremity of the fissure, one of the lips of the division being lower than the other, had contracted a new adhesion, for some lines, with the cellular coat—presenting altogether the appearance of a commencing cicatrization. The cellular tunic was perfectly sound, through the whole extent of the aorta, and particularly opposite to the transverse rent. Morgagni and Nicholls had previously noticed this extravasation in the coats of the artery; the latter having observed it in the descending aorta, on dissecting the body of George II. of England. Other cases have since been described by Guthrie and others—and one very lately has been recorded by Dr. M'Lachlan, in No. 1. N. S. of the *Glasgow Medical Journal*, for 1833. The fissure very generally has the appearance of a rupture, running in a circular direction, with marks of disease in the internal and middle coats, and apparently a sound state of the external coat. The most singular and rare modification of this, so called, dissecting aneurism, is described by Mr. Shekelton, in third vol. of *Dublin Hospital Reports*. He met with two cases in which the blood, driven through the internal and middle coats, not only dissected the middle from the outer coat, for the space of four inches, but returned, through another rent, into the canal of the artery, thus forming, at this particular part, two channels for the passage of the blood. The new channel or sac became lined with lymph, thus presenting a smooth surface, and, the rent being enlarged, transmitted the greater portion of the blood: the original tube compressed by the swelling, had its direction altered, and the new-formed canal assumed its place.

A dilated condition of portions of the arteries is often found connected with aneurisms, and during life has been frequently mistaken for a proper aneurismal tumour. The anatomical characters of these dilatations are, however, peculiar: they involve, in every case, all the arterial tissues and the whole circumference of the vessel—although portions of the circumference are occasionally more dilated than other parts, like pouches. The dilatation, however, is spindle-shaped (*fusiform*), arising gradually, and as gradually terminating, so that the tumour is largest at the base or connexion with the artery, allowing of no stagnation or interruption of the blood, which passes readily during the systole of the heart or arteries; hence, no coagula form, and the tube is completely pervious. The coats of the vessel are usually altered in appearance, being frequently thickened, but sometimes thinner than natural—often with pultaceous, cheesy, or calcareous deposits. In protracted cases, ulceration or rupture of the lining membrane may ensue in different places—so that the blood is entangled, and may then coagulate, not in layers, but in a uniform pultaceous mass. Under these circumstances, an aneurism may form at the ulcerated point, being grafted, as Scarpa would express it, on the dilated artery; but sometimes coagulation exists and yet no aneurismal swelling is formed. Mr. Guthrie describes a preparation, No. 372, in the Hunterian Museum, which he regards as *unique*, where the coagula occupied the whole inner circumference of the vessel, leaving a passage for the blood through its centre as a proper canal.

This *dilated condition of an artery, preternatural enlargement or dilatation, aneurismal state*, as it has been variously termed, is most frequently observed in the arch of the aorta, but sometimes in the descending aorta, in the carotids, and the larger trunks of the extremities. "It is not uncommon," says Mr. Guthrie, "in the arteries within the skull, and I have twice seen the ophthalmic arteries in the orbit dilated in this manner." (p. 48. *On Diseases*, &c. *of Arteries.*) It is often seen, says Mr. Hodgson, at the angles where arteries divide. Dilatation of arteries may exist for many years without perceptible increase, and is not, *per se*, dangerous, unless complicated with rupture or ulceration, and the formation of a genuine aneurism. It not unfrequently disappears entirely. (Vide *Arteries.*)

There is still another modification of diseased artery, which may be the foundation of aneurism—described perhaps originally by Stentzel, in 1723—but first

supposed by CORVISART to be connected with the formation of aneurism. It is an encysted tumour or tumours, containing a "substance not so hard as tallow, and of a deep red colour, otherwise very similar to clots of blood, a long time formed, which adhere to the inside of aneurismal sacs." (p. 242, Amer. edit. of CORVISART *on the Heart.*) His idea was, that this tumour, continuing to enlarge, would have pierced the internal membrane, and the blood then entering the cyst would form an aneurism —the sac being thus previously prepared. In this idea, he is supported by GUTHRIE, and also by M. BÉRARD, who, in 1829, presented to the Anatomical Society of Paris, an account of similar cysts which in several places had opened into the artery. HODGSON, however, views the cases described by CORVISART, in a different light. (Vide *Spontaneous Cures;* also, *Formation of Aneurisms.*)

Condition of Aneurismal Tumours, as ascertained by *dissection*, from their incipient stage to their termination by rupture or sloughing, or to their obliteration and cure.

Dissection reveals the truth of our definition of aneurism, as being "a sanguineous tumour communicating by a contracted orifice with an artery." It is a cyst containing blood.

Condition of the Blood in the Tumour. In the very early stages, the blood is sometimes, although rarely, entirely fluid, especially where it passes readily into and from the artery, and where the circulation has been active. In such cases, pressure can obliterate the swelling. In a short time, however, the blood will be found partially coagulated—at first in soft clots, but very soon in laminæ on the circumference of the swelling, while fluid blood occupies the centre. Pressure now diminishes, but does not obliterate the swelling. As the tumour augments, the laminated coagula become more dense and firm, and occupy large portions of the cavity. The exterior layer is in some instances almost cartilaginous—of a reddish white, or yellowish colour. "Sometimes, it is quite opaque and firm; at other times, and in very old aneurisms, partly transparent, resembling horn or glue a little warmed or softened before the fire. In some cases, further changes will be found to have taken place exterior to this, and the matter deposited will be found softer, more pliable, easily broken up between the fingers, and offering little opposition to the passage of blood through it." (GUTHRIE, p. 51. *Op. Cit.*)

These layers often adhere very intimately with each other, and still more so with the aneurismal cyst; but they never become organized, and of course no vital adhesions exist, as supposed by some authors. Their firmness and number explain why pulsations are so faint in old tumours, and in some instances even imperceptible.

Condition of the Aneurismal Cyst—in early stage. On this point, great and protracted discussion has existed, and even yet continues, although one to be determined not by hypothesis or by argument, but by ocular demonstration. Prior to the middle of the last century, very little precision existed in the anatomical descriptions of aneurism, and much was detailed as possible, without examination. The opinions of pathologists were divided as to the question, whether, in aneurismal tumours, the coats of the vessel formed the parietes, or whether there was a rupture or ulceration of one or all of its tunics. The learned and accurate Italian anatomist and surgeon, Professor SCARPA, investigated this subject with the greatest attention, by examining the writings of his predecessors, and especially the bodies of individuals dead with diseased arteries. He concludes (p. 113.) that this disease is invariably formed by the rupture of the proper coats (the internal and middle) of the artery, and that the aneurismal sac is never formed by a dilatation of the proper coats of the artery. The authority of SCARPA, supported by his facts, has had great influence; but subsequent examinations by the most distinguished modern anatomists, with special reference to this subject, show that some limitation must be given to his general deductions. In a preparation in the Hunterian Museum, already alluded to as an example of dilated artery, "two small depressions are seen on the posterior part, midway between the valves and the arteria innominata, one larger than the other, and each containing a bristle. They are the commencement of two small aneurisms; the edges are well defined internally, and the sacs equally as well externally. In the larger one, the external coat is turned back, as well as the middle one; the inner one remains entire and continuous with the inside of the artery." "The defined edges of the cavity are here seen, not to depend on a rupture of any kind, but on a thickening of the vessel at the part. The smaller aneurism shows the same thing: the edges are remarkably well defined." Very many accurate dissections, by the best pathological anatomists, could be detailed, in proof of the fact that in *many*

small aneurisms, all the coats of the artery can be traced through the whole circumference of the tumour—the parietes being formed by a dilatation of the internal and middle coats, as well as of the external—forming the *true aneurism* of most pathologists, the existence of which Scarpa positively denied. Nevertheless, this surgeon has demonstrated that in aneurisms of any magnitude, the inner and middle coats very seldom form any portion of the swelling. Very frequently, these tissues can only be traced to the lips of the orifice, sometimes to a short extent on the sides of the swelling, and very generally disappear at its most prominent portions—where the sac is mainly formed by the external or cellular coat of the artery—or, as Scarpa, who believed the arteries to have but two proper coats, terms it, the cellular sheath.

The internal coat can often be traced over the whole sac, but is deficient in spots or patches—giving it a honey-comb appearance, in consequence of ulceration excited by atheromatous, steatomatous, or calcareous, depositions. "The cellular tunic of an artery, distended in the form of a sac in a true aneurism, the internal and middle coats of which are already ruptured, sometimes presents a smooth surface, altogether similar to that of the internal tunic," "and may thus be mistaken for a distension of this internal coat." (II. 87. Boyer.)

The walls, therefore, of *aneurisms even of moderate size*, with few exceptions, are formed only of the external coat of the artery—the internal and middle tunics having been ruptured, or else partially or completely destroyed by ulceration. The external coat is not preternaturally thinned as if by distension, but, at this period, is thickened, and the coagula of blood, now existing in dense fibrous layers, are often intimately combined with the external coat, or with the remains of the internal and middle coats—so as to give the appearance of vascular union, and even organization, which, however, do not exist.

On examining the sac from without, it will be found involving the surrounding tissues. The cellular sheath is closely adherent to the sac as formed by the external coat of the artery—and as the tumour enlarges, any and every tissue which is pressed upon, becomes at first somewhat thickened and adherent to the tumour, and soon, by the process of ulceration, forms the actual sac in which the blood is contained. This "progressive ulceration" is from within outward—so that the external coat of the vessel and its sheath, after sustaining a certain degree of pressure and distension, by which inflammation and thickening are caused, ulcerate. The blood then comes in contact with any exterior tissue which may have adhered to the sac, and so, in succession, until an external surface, skin or mucous membrane, is opened, when the blood is freely effused. Infiltration of the cellular tissue is very rarely observed, as the surrounding tissues are all thickened and closely adherent prior to ulceration: neither are there ordinarily any purulent collections or depositions. Where adhesion has been less perfect, or a sudden rupture has taken place, effusion of the contents of the tumour ensues, sometimes into the cellular tissue or into serous cavities—as of the pleura, the pericardium, the peritoneum; sometimes into large neighbouring arteries, as aneurism of aorta into the cavity of the pulmonary artery. In external aneurisms, effusion into the cellular tissue is very uncommon. Hodgson, however, details the case of a small femoral aneurism in an old man, being ruptured, and the blood was injected rapidly and fatally into the tissues of the limb. These are exceptions to the general fact, of rupture or sloughing of the sac into mucous canals, as the trachea, œsophagus, stomach, intestines, &c., or upon the skin.

It is affirmed by S. Cooper, Boyer, and others, that rupture on the skin is almost always preceded by the formation of an eschar, which is detached by the force of the circulation—while on serous membranes there occurs a rupture without sloughing, in consequence of slight adhesions existing and some sudden exertion being made. Although pus is not ordinarily formed, yet the degree of irritation is sometimes, though rarely, so great that an abscess results, which may open prior to the aneurism, or, in some extraordinary cases, may become involved with the aneurismal tumour—possibly by ulceration: of this, an example is detailed by M. Delort. A tumour existing on the left side of the sternum, twice, at intervals of three months, discharged good pus and some spoonsful of altered blood, with subsidence of the tumour and an apparent cure. The patient, however, died without any return of the hemorrhage, and the external tumour was discovered to be the expansion of an enormous aneurism of the aorta.

Dissection, therefore, shows that in *advanced or ancient aneurisms*, the parietes of the tumour are formed of the remains of the arterial tunics at the sides and base, supported by the surrounding tissues, al-

tered, and at first rendered dense and adherent by the adhesive inflammation, but afterwards destroyed by ulceration or gangrene. In this way, cartilages and bones, as well as fasciæ, muscles—cellular, serous, and other tissues, may, in succession, form portions of the sac, but eventually yield to the combined influence of pressure and irritation. Hence, the blood of an aneurismal tumour is, in some cases, in actual contact with bone which for a long time forms part of the parietes of the sac: that portion of bone subjected to the pressure and irritation, but not ulcerated, becomes sometimes remarkably hard. (Bérard and Marjolin.) The periosteum also occasionally forms a portion of the sac, and has been found extensively ossified, earthy matter having been secreted during its development. (Hodgson, p. 81.) The destruction of bones and cartilages has been especially noticed in internal aneurisms of the thorax, in which the sternum, ribs, and clavicle, have been partially removed—or ulceration has occurred through the membranes and cartilages of the trachea, or the bones and cartilages of the spine—so that effusion into the lungs or into the spinal canal, has resulted. The cartilaginous tissue is often found little affected when great destruction of the bones has occurred.

Condition of the Orifice, communicating with the Artery. This also varies in different preparations. Very generally it is quite small compared to the size of the tumour, with the edges well defined, often indurated, prominent, and smooth; at other times, the lips of the orifice are irregular, ragged, and portions even pendulous. The internal and middle coats often terminate at this orifice, but can frequently be traced within the sac. The opening is usually towards the central part of the sac, but in some cases, especially in external aneurisms, towards the superior extremity: the external coat being dilated, the fibrous and serous coats thus often exist as an imperfect partition between the sac and artery (Bérard), perhaps always, when the aneurism commences from a solution of continuity in these tunics and not by dilatation. In large aneurisms, the orifice is found augmented, the communication with the tumour being more direct from the destruction of larger portions of the internal and middle coats. Sometimes the destruction of these tissues involves the whole circumference of the vessel, the external coat being dilated into a spherical tumour, and the artery appearing to enter on one portion and escape at the opposite side. On laying open such sacs, the prominent orifices of the vessel are observed on opposite points. In fig. 3d of the 10th plate of Scarpa *on Aneurism*, French edition, is exhibited a femoral and a popliteal aneurism thus constituted: a small portion of the artery is observed between the two aneurisms and projecting into each sac. On examining very small aneurismal tumours, the orifice of communication with the artery is frequently large in proportion to the tumour; in some cases, very irregular, evidently arising from rupture as in dissecting aneurisms; in other cases it is smooth from ulceration excited by atheromatous, steatomatous, osseous, or other degenerations of the tissue.

The *form*, *size*, and *number*, of aneurisms, are exceedingly various, and admit of no specific description. As already intimated, they are generally spheroid, attached to one side of an artery—but owing to the resistance of surrounding tissues, especially of fasciæ and bones, they are moulded into various shapes. Their size depends also on the resistance of the tissues—the activity of the circulation—the magnitude of the vessel to which they are attached—distance from the external surface, &c. In some instances, where the artery is preternaturally dilated as formerly described, an aneurismal sac is found developed on a portion of its circumference, with a contracted orifice, giving the appearance of a double aneurismal tumour, and is sometimes termed "*a sacculated aneurism.*" Another, and a more common variety of sacculated aneurism is where a considerable portion of the artery is diseased and dilated—while portions are distended into irregular pouches—which are generally thinner than the remaining parts of the swelling. Guthrie states that, No. 366 of the Hunterian collection, exhibits this form of the complaint in the aorta ascendens. "The sac seems to be strictly formed by dilatation and thinning, in proof of which, the external coat at one part is reflected, and a bristle placed under it; the middle coat is also turned back in a different direction, and a bristle placed under it; the internal coat is seen *in situ;* one of the small sacs arising from the larger one, and looking like a nipple, has opened into the pulmonary artery by a nearly circular orifice, about one fourth of an inch in diameter." Delpech, in his edition of Scarpa's *engravings*, gives (plate IX. fig. 13, 14, 15.) three views of a small sacculated aneurism. They exhibit the diseased state of the artery—and the atheromatous, steatomatous, and osseous concretions, often

the foundation of aneurism; also, the outline of the whole swelling, three inches in length—irregular by five pouches, formed by the cellular envelope of the artery alone—the corresponding portions of the internal and middle coat being ulcerated. In another point, there is an ulceration of the internal coat alone. On the external surface, there are many small ulcerated points interesting the whole thickness of the cellular cyst, at the bottom of which may be seen the fibrous lamina of blood.

Aneurisms usually appear *singly;* but not unfrequently numerous tumours exist, even when one or two only are manifested by external signs. DELPECH has counted as many as sixty in the body of one individual; and a morbid condition of the arterial system, the foundation of aneurisms, often exists, as already intimated, very extensively. HODGSON, p. 306, alludes to two cases of individuals perishing during the operation on the thigh for popliteal aneurism, from the rupture of an aortic aneurism in the thorax.

Aneurismal tumours are not, however, always fatal. Recoveries sometimes occur, occasionally without, but more frequently with, artificial assistance; opportunities for dissection occurring at indefinite periods afterwards. In such cases, the parts are found in different conditions. If the cure has been long effected, the remains of the tumour are very small, and hard, and have been mistaken for exostosis; the walls are thick, and the coagula nearly or altogether absorbed: if any coagulum remains, it is usually dense, whitish, sometimes reddish and presenting some vestiges of layers: the artery, especially, if of small size, is found obliterated, and reduced to a ligamentous line, above and below the tumour, to the first collateral branches, as when ligatures have been applied. If dissection be made soon after the aneurismal symptoms have disappeared, the tumour will be found diminished in size, firm, but not hard, and completely occupied with coagula, which almost always extend through the orifice into the artery, obstructing the passage of blood in this tube. In proportion as the time has been prolonged, will be the changes observed; viz. the greater condensation and firmness of the tumour, the absorption or solidity of its contents, the condensation of the coats and the closure of the tube of the artery, with absorption of the coagula formed in its cavity. These are the usual appearances, but Mr. HODGSON has adduced some cases of dissection, chiefly made by himself, which exhibit, in aneurisms of the aorta, a condensation of the tumour, with a coagulation of all the blood in its cavity, while the vessel remained pervious, not being in the least encroached on by the coagulum in the tumour. The surface of this coagulum at the orifice in the vessel was covered by a thin membranous pellicle, so that it was evident no blood had entered the sac for a long time. In these cases, the size of the aneurism, the pulsations, and other symptoms, had diminished or disappeared before the death of the patient. Sir ASTLEY COOPER communicated to MR. HODGSON notes of a dissection of an aneurismal tumour in the groin, which differs from each of the above mentioned cases. "The femoral artery, from its origin to the extent of more than three inches, was dilated into a sac, which was lined on all sides with very firm layers of coagulum, which had a fleshy appearance. This deposition did not completely obstruct the passage through the sac; for an irregular canal, which in some places was larger than the natural calibre of the artery, still remained through its centre. The coagulum that formed the immediate boundary of this canal was more condensed than in any other situation, and exhibited a membranous appearance," as in the cases of aortic aneurism. MM. MARJOLIN and BÉRARD mention a dissection in which "a tumour on the aorta, almost equal to two fists, was filled with concentric coagula, exceedingly firm, in the centre of which was a complete canal, with smooth surface and apparently lined with a false membrane, continuous at the superior and inferior extremities of the aneurism with the internal membrane of the sound portions of the artery." They think it probable that the progress of aneurisms thus situated is arrested. Mr. HODGSON has not met with any decided cases of complete obliteration of the tumour and of the orifice communicating with the artery. In the brain of a lunatic, "a small tumour, about as large as half a pea, of a dark colour, was observed to be attached to one of the anterior arteries of the cerebrum, about an inch from its origin. This tumour was very hard, and appeared intimately connected with the coats of the vessel. On laying open the artery in a longitudinal direction opposite to the tumour, a small circular opening was observed in its coats, corresponding to the part at which the tumour was attached. This opening, which occupied but a small portion of the circumference of the vessel, was completely plugged by the base of a firm lamellated coagulum, which filled the cavity of the sac, but did

not extend into that of the vessel, so that the continuity of the latter was restored, and the ingress of blood into the former was prevented." This was the nearest approach to a perfect cure of spontaneous aneurism which fell under the notice of Mr. H.; but he quotes as examples of a cure more nearly complete, the cases of CORVISART, already referred to (see *Condition of Aneurismal Arteries*), and apparently with truth, at least in the opinion of most authors, although BÉRARD and GUTHRIE believe with CORVISART that the tumours were not the remains of aneurisms, but encysted steatomatous formations which might have proved the foundation of aneurisms. GUTHRIE's criticism is founded on the assertion that the substance in the tumours was not hard, but of the consistence of tallow or suet, and hence could not be the remains of coagula; but he, himself, in another place, has pointed out this softening of the coagula in an old aneurism; and his hypothesis is also opposed to the description given by CORVISART himself. The tumour was of the bigness of a walnut, and of a blackish colour. The external membrane was a real fibrous sac, adhering intimately to the parietes of the aorta, with which it appeared, in some measure, confounded. "This species of cyst contained a substance not so hard as tallow, and of *a deep red colour, otherwise very similar to clots of blood, a long time formed, which adhere to the inside of aneurismal sacs*." No communicating aperture with the artery could be found: the external layers of the aorta, at the place corresponding to the cavity of the cyst, were destroyed, and the thickness of the parietes of the vessel was, in this part only, much thinner than at any other. On laying open the aorta longitudinally, no aperture was detected, but there was a grayish livid spot answering to the base of the cyst. In the same subject, there was another precisely similar tumour, but somewhat smaller, on the aorta, a little above the cœliac artery. In another dissection, some four or five tumours in the abdominal aorta and primitive iliacs were found, altogether like the one in question. There is strong reason, therefore, to regard, with Mr. HODGSON, these tumours as the remains of aneurisms, in which the cure was so far complete that cicatrization had occurred at the orifice of the swelling, instead of considering them as steatomatous degenerations.

Other changes are observed in the progress of aneurismal swellings, more or less favourable. In some instances, several preparations of which, GUTHRIE has described from the Hunterian Museum, the lower portion of the artery is completely occluded by a coagulum, and sometimes obliterated; the upper orifice being unobstructed, and blood still entering the tumour, which is generally nearly filled with coagula; but, says GUTHRIE, p. 91, "these preparations show that when the lower end of the artery has been obliterated, the aneurism has not ceased to increase." This is especially the case if arteries pass off from the sac, as will be noticed hereafter.

Not unfrequently, aneurismal tumours exist at the bifurcation or ramification of arteries, so that the sac is formed in reality by two vessels. Often, also, arteries of considerable size go off from the dilated sac; in these cases, laminæ of coagula are formed, which sometimes close all the communicating vessels excepting the main trunk, so that they eventually are obliterated for a short distance from their origin.

M. BÉRARD affirms, after much investigation, that "the coagula on the internal surface of the cyst, *almost universally*, close the orifices of vessels arising from the sac." "Neither is this the only cause why the branches are impervious, but the effusion of coagulable lymph contributes much to their occlusion; so that some are found closed by coagula, others by the adhesive inflammation."

Sometimes, especially when a larger vessel goes off, the blood passes not only through the main artery, but also through the sac and coagula, into the communicating vessel. In other aneurisms, the branches are obliterated not at their origin, or by the formation of coagulum, but by pressure from the aneurismal tumour, at some short distance from their roots.

Again, in dissections of cases where the aneurismal swelling has been destroyed by sloughing, the parts are found as in other cases of mortification; a deep ulcer, with destruction of a portion of the artery, the upper and lower orifices of which are obstructed by coagula of blood, or completely obliterated by the process of thickening and contraction of their parietes. Sometimes, aneurismal tumours are found in a state of suppuration, from the activity of the inflammation in their coats the pus and blood being intermingled, and ulceration of the sac having ensued. The artery, in such cases, is usually closed either by coagula or adhesions. Sometimes, however, the closure is not perfect, and hemorrhage into the cellular tissue, or externally, has ensued, being the immediate cause of death.

Changes in the diseased artery, and in the collateral and anastomosing vessels. The chronic inflammation and consequent disorganization which exist in aneurismal arteries, are not always confined to the situation of the tumour, but often involve not merely other portions of the same vessel, but also its ramifications, and even large portions of the arterial system, as has been fully demonstrated. But certain changes consequent on the occurrence of an aneurism, are noticed in the aneurismal artery, its ramifications and inosculating vessels, of great importance to be known.

The artery above the tumour is occasionally found larger than natural, while below the tumour it is almost universally diminished in size, and its parietes somewhat thickened: in some instances, this lower portion is exceedingly small, and, as has been mentioned, obstructed and obliterated.

The ramifications of the artery above and below the aneurism are, if the disease has existed any time, preternaturally dilated. This dilatation extends to the anastomosing vessels, connecting the collateral branches above and below the location of the aneurism; and in some degree, even to all the inferior arteries of the limb, the continuation of the main trunk excepted. Hence, injections pass more freely through the vessels of aneurismatic than of sound limbs, and, says Scarpa, p. 218, "what is still more wonderful on this point is, that even in limbs affected with aneurism, in which we do not observe any evident increase of the diameter of the lateral vessels, the injection passes with more facility than in sound limbs." Should any portion of the aneurismal artery be obliterated, this enlargement of the collateral and anastomosing vessels becomes much more evident; but in a manner, not, *à priori*, to have been expected. If an injection be thrown into the arteries of an aneurismal limb, soon after the obliteration has occurred, the dilatation will be observed chiefly in the capillary vessels, while few or no vessels will be large enough to trace the inosculation. If the injection be delayed for a longer period, the capillaries will not be so fully injected, but several large and tortuous vessels will be found developed in situations where they were not expected, and anastomosing freely with each other, so as to restore the communication between the superior and inferior portions of the main trunk. Should an examination not be made for some years after obliteration, the capillary vessels will be found in their natural state, most of the anastomosing vessels will have resumed their original diminutive size, while one or more have continued to augment, forming large channels for the passage of blood, in place of the original vessel. (Guthrie.) In these cases, the obliteration does not extend to any great distance from the aneurism, the artery remaining pervious wherever the collateral vessels are observed, as after the application of ligatures. Hence, in cases where the main trunk is obliterated in two points, either by disease or by ligatures, or both, the intervening portion of the artery is not unfrequently pervious. This has been seen in the thigh, where the popliteal artery has been obliterated by an aneurism being cured, and the femoral artery by a ligature; the intervening portion has been found open and receiving one or more collateral arteries.

From comparative experiments and observations on aneurismal limbs, it hence appears that there is a gradual development of the capillaries, and of the anastomosing and collateral arteries, commencing soon after the formation of the tumour, and augmenting more or less rapidly according to various circumstances: that this development is first manifested in the capillaries, then in the anastomosing vessels, and finally, in the collateral branches as they leave the main trunk: that the degree of development is always greatest when complete obstruction exists in a portion of the main trunk: and finally, that when some years have elapsed after a cure of the disease with obliteration of a portion of the artery, the blood-vessels return nearly to their pristine condition, one or two branches only being preternaturally dilated, and acting as substitutes for the main trunk.

Condition of the tissues or organs connected with or dependent on the diseased artery. Some of the structural changes excited in the surrounding and dependent tissues have been already noticed, and, under aneurisms of individual arteries, other transformations will be detailed. They arise from the pressure of the aneurismal swelling, irritating the neighbouring tissues, and impeding or destroying their functions, thus introducing the secondary symptoms already detailed.

The *muscles*, for example, are often turned from their natural direction; very frequently are elongated, or flattened by the tumour, and lose their natural appearance and colour, accounting for the impediment to motion or the actual loss of muscular power observed.

The *ligaments* are often found thickened or ulcerated, so that the motions of

joints are rendered difficult, or impossible; sometimes dislocation ensues.

The *bones* exhibit various appearances. As already intimated, they are often ulcerated: occasionally, they are excavated by the pressure of an aneurism, without ulceration, the cavity being covered with membranes (Hodgson, p. 79.); sometimes they are more indurated and even enlarged, "*hypertrophied.*" (Guattani.) Often they are thinned, and occasionally curved at the point of pressure.

The *joints* near the aneurism are stiff, from the induration of ligaments, capsules, &c., or sometimes injured or even destroyed by suppuration or ulceration.

The *blood-vessels*, arteries and veins, and the *absorbents*, are in many instances closed by the pressure, or more frequently completely obliterated. In such cases, there is usually great œdema of the parts below, often a varicose condition of the veins, and occasionally, complete disorganization of other tissues, from interruption of the circulation.

The *nerves* also present analogous changes, being often flattened, or enlarged and indurated where pressed upon, and not unfrequently disorganized; hence the neuralgic pains, or paralytic condition of the parts below, and probably also, an additional cause of sphacelus.

The *cellular membrane and skin* in large aneurisms of the extremities are found exceedingly tense, not merely over the tumour, but in the whole circumference of the limb on a line with the swelling, thus producing pressure on the blood-vessels of the limb, and inducing mortification. Dr. Physick, in his lectures, used to detail a case of this kind.

Fasciæ and aponeurotic membranes may sometimes be found similarly affected by pressure.

Various, but similar, alterations are observed in other tissues, to be detailed under appropriate heads hereafter; but now it may be observed, that dissection very universally presents the evidences of the adhesive inflammation, preceding the ulcerative; so that the cellular tissue, blood-vessels, and serous cavities, are closed by the effusion and organization of lymph, prior to their being penetrated by the ulcerative process. This does not apply, however, to mucous canals, the internal surfaces of which never cohere by the adhesive process; hence, aneurismal swellings often open on mucous membranes as on the skin. Sometimes, indeed, mucous tubes of small diameter are obliterated by the pressure, causing a thickening and induration of their walls, as occurs in strictures of the urethra: this is the reason why aneurisms are not more frequently found opening into the bronchial tubes.

The above history comprises the most important facts connected with aneurisms, and is preparatory for the consideration of their predisposing and exciting causes, mode of formation, pathology, progress, termination, and for establishing suitable indications for their treatment.

Predisposing Causes. Aneurisms never form in healthy arteries. This general fact has been denied, and clinical observation and direct experiments have been adduced in opposition. Lancisi asserted that aneurisms will form from wounds of arteries, interesting merely the two external coats, so that the internal coat alone forms the sac by its dilatation; but his assertion has little importance, as he details no dissections to confirm it. Subsequently, Haller made experiments on the mesenteric arteries of frogs, and affirmed that if the external and fibrous coats be carefully peeled off, aneurismal tumours form by dilatation of the internal coat, and thus constituted, are termed "internal mixt aneurisms" or "herniæ of the arteries." Boyer, however, maintains that Haller mistook an ecchymosis of the cellular tissue, or "a diffused traumatic (*false*) aneurism," for an aneurism by dilatation of the internal tunic. This is the more probable, as subsequent experimenters have invariably failed in similar attempts. Mr. John Hunter exposed the carotid artery of a dog, and very carefully "skinned it with a knife even to transparency:" the wound was closed and the animal set at liberty. No aneurism formed, and on subsequent dissection the vessel was found nearly obliterated and its walls thickened by the adhesive inflammation. These experiments were repeated by Sir E. Home and Professor Scarpa, with the same results; showing that on animals at least, the internal and middle coats of healthy arteries, even when unsupported by the strong cellular tunic, will not dilate when exposed to the *vis a tergo* from the heart and arteries.

Experiments also show that the momentum of the blood will not dilate the external coat when the internal and middle have been ruptured. Mr. Jones tied a ligature so firmly around an artery, as to rupture the internal and middle coats. He then removed it and closed the external wound. In all his experiments, the artery became obliterated by the adhesive inflammation. Mr. Crampton, and others, after

similar trials, deny that the artery is always obliterated, but acknowledge that its walls are thickened and its canal exceedingly diminished, and, in some instances, closed. This fact is confirmed by the daily observation of surgeons, who never observe aneurisms by dilatation, resulting from ligatures to arteries, rupturing the internal tunics, or arising from wounds, inflammation, ulceration, or even sloughing, of the external coat. Even when large arteries are long exposed at the bottom of deep and lacerated wounds, "deprived even of their exterior cellular tissue," and the subjects, of course, of inflammation and suppuration, aneurisms never result. The parietes of the vessel become thicker, and the diameter lessened. Boyer has observed these consequences in a brachial artery, so denuded by an anthrax, that the pulsations were visible for ten days. Notwithstanding, therefore, the comparative weakness of arteries so injured, no dilatation ensues; on the contrary, thickening, and, often, obliteration, succeed, whatever may be the momentum of the circulation, unless the inflammation be so active as to cause ulceration or sloughing, when hemorrhage or a "*traumatic*" ("*primitive false*") aneurism may result. Violent contusions, also, of arteries, are not followed by dilatations, either immediately, or as a consequent of the succeeding inflammation. So also, if a wound of an artery should heal and the tube remain pervious (a rare event), we want evidence to prove that dilatation will ever succeed. Mr. Guthrie thinks that an artery so circumstanced "is liable to the formation of an aneurism by the gradual dilatation of the part of the artery on which the cicatrix has taken place." He alludes to a case of a pulsating tumour at the bifurcation of the carotid, occurring some months after a wound from an arrow, and which he considered as a tumour from dilatation of the artery, and not from extravasation of blood: but his patient was killed in battle, and no opportunity occurred of ascertaining the exact nature of the disease. That aneurisms very frequently follow contusions and wounds of arteries, there can be no doubt; but such aneurisms very universally arise from effusion into the cellular tissue. If dilatation of any of the arterial tunics should ever be detected, the facts already adduced warrant the inference that some prior disease existed in the vessel. This conclusion is not invalidated by the experiments originally made by Mr. Nicholls (vide *Philosoph. Trans.* Vol. XXXV.), and subsequently repeated by Hodgson and others, in which rupture of the internal and middle coats, and a dilatation of the external coat, were caused by suddenly and forcibly injecting air or water into arteries. No such force is exerted by any injecting power in the heart, otherwise aneurism would be an almost universal disease. And these experiments were made on dead vessels, while Bichat informs us he could never succeed in dilating living arteries by injections.

Again; it is not only true that no dilatation occurs in the manner supposed, but that even a rupture of the internal tunics of healthy arteries is never observed unless the force be so great as to interest other tissues, as in cases of severe contused or lacerated wounds. Although the experiments of Nicholls, Jones, &c. show that these tunics are more brittle, and far less capable of extension and dilatation, than the external coat, yet nevertheless, rupture does not occur under ordinary circumstances. Richerand having asserted that a sudden extension of the leg or the thigh would lacerate the internal and fibrous coats of the popliteal artery, Mr. Hodgson repeated the experiment, without producing this result, unless the force were so great as to rupture the ligaments of the joints; and he affirms that he has "never met with a laceration of the coats of an artery which had not undergone some previous morbid alteration."

The general conclusion from the facts detailed, that aneurisms by dilatation of one or all the arterial tunics, never occur in healthy arteries, is confirmed by dissection, showing, in perhaps every instance of dilatation, a preternatural softness or brittleness of the internal coats at least, and very generally some preternatural depositions, as formerly detailed. This deduction is stronger as regards a "*hernia of the arteries.*" It has never been observed in healthy vessels, and there is little doubt that even in diseased conditions of these tubes, the dilatation of the internal membrane into an aneurismal sac has not yet been noticed. To this conclusion we might, *à priori*, be led by the friability of these tissues, which is very generally greater during the process of inflammation, and also by their want of physical strength, especially when diseased, and when deprived of the support of their external tissue. In Nicholls' experiments by injection, they were always ruptured, although the external coat was merely dilated; and almost every morbid anatomist acknowledges that he has not observed in any diseased artery a hernia of the internal tissues. The only preparations men-

tioned are those of MM. Dubois and Dupuytren, who, in 1804, presented them to the Anatomical Society of Paris, as genuine examples of this variety of aneurism. Difference of opinion, however, exists among the distinguished anatomists who have seen these preparations. Beclard held an opposite opinion, and Boyer, who wrote in 1818, denies that a hernia of the arteries has ever formed. He affirms, respecting the above preparations, "that the edges of the rupture in the internal and middle coats, being rounded off by the process of cicatrization on the inner face of the cellular sac, the continuity of the interior smooth surface of the artery, with that of the sac, may be mistaken for a distension of the internal tunic; but it is easy to distinguish the prominent opening (*bourrelet*), sometimes circular, sometimes irregular, which marks the place of rupture in the proper coats, and to be assured, by dissection, that the internal coat does not pass this point, and that all beyond is cellular." (II. 87.) A similar explanation is adopted by MM. Marjolin nd Bérard. Hence it is doubtful whether an internal mixed aneurism can possibly form, and we may safely affirm, that if it should form, the dilatation would not be great, before rupture, ulceration, or sloughing, would ensue.

The *predisposing cause*, therefore, of spontaneous aneurisms, is a morbid condition of the artery at the seat of the disease. This morbid state, from the facts adduced, is the result of chronic inflammation, and involves, in all cases, a diminution of the physical and vital strength of all the coats of the artery. There usually is greater friability of the internal and middle coats, and rupture or ulceration of portions of these membranes, with the various atheromatous, steatomatous, or osseous, degenerations of tissue which have been already noticed. (Vide *Arteries.*)

Many other circumstances have been detailed as predisposing causes to aneurism, but they are so, only in a secondary sense, acting indirectly, by exciting inflammation and the consequent degeneration of the arterial tissues. Thus, syphilis, mercury, rheumatism, repelled eruptions, great or constant muscular effort, old age, intemperance, &c., in no other sense, predispose to aneurism, than by exciting chronic arteritis, the cause of that alteration in the physical and vital powers of arteries on which aneurism depends.

So, also, a preternaturally dilated state of the arteries, on which aneurisms are frequently grafted, is a consequence of the same degeneration of tissue, and is sometimes so general as to be regarded as evincing a peculiar susceptibility to aneurismal complaints. It has been termed "*an aneurismal diathesis*," and regarded as consisting in a state of weakness or want of elasticity in all the membranes of the arteries. The occurrence of aneurisms chiefly in middle and advanced life, is to be explained in the same manner; as a diseased state of the arteries is then frequently observed, while it is rare in infancy and youth. Females are much less liable to aneurisms than men, not from any peculiarity in the structure or functions of their vascular system, but from their comparative exemption from the usual exciting causes of arteritis, from their quiet lives, freedom from violent muscular efforts, exposure, &c.

Subordinate, however, to the general and essential predisposing cause, a morbid condition of the artery, there are circumstances which predispose to aneurism, especially in particular arteries; such as a manifest disproportion between the strength of the heart and arteries, natural or acquired. MM. Marjolin and Bérard mention hypertrophy of the heart, or a thinning of the arterial coats. Aneurisms are more frequently found at the curves of arteries, or at their bifurcations, against which portions the blood impinges with greater force; hence a reason for the frequency of dilatations of the aorta and its immediate ramifications. Proximity to the heart no doubt contributes to increase this frequency, by the greater momentum possessed by the blood in the aorta; and the influence of curvature near the joints is increased by the sudden and not unfrequently violent motion to which arteries are here subjected.

The predisposition existing, the *occasional*, *immediate*, or *exciting causes* of aneurisms, are various, and may be referred to three general heads: those which increase the momentum of the blood in the diseased artery; those which aggravate the morbid irritation in the arterial tissues, and those which still further weaken their parietes.

To the former, must be referred stimuli, solid or fluid, febrile excitement, active or passive congestions of blood, violent passions and emotions of mind, severe exercise, inordinate action of the heart, &c., all which either accelerate the circulation or increase plethora, locally or generally.

The second class of exciting causes includes all irritations which directly or indirectly aggravate the chronic inflamma-

tion of the affected artery; such as contusions, wounds, diffused cellular, erysipelatous, or other inflammatory affections of the surrounding tissues, the occurrence of fever, disorder of the stomach, bowels, &c.

The parietes of the vessel may be further weakened by the occurrence of ulceration of the internal coats, or by rupture of their tissues. This last may sometimes, perhaps, be induced simply by the momentum of the blood, but usually by some sudden or violent muscular exertion. Of this, there can now be no doubt, as cases are numerous in which aneurisms have formed suddenly after some severe strain, often accompanied with a sensation of tearing, and where subsequent dissection evinced that a rupture had occurred. Hence, porters, post-boys, and jockeys, are peculiarly liable to popliteal aneurism. In these cases of aneurisms from strains, there is the usual predisposition, for it has been already shown that rupture of the internal coats does not occur in healthy vessels, and even when artificially produced, no dilatation of the external coat would ensue. This conclusion is confirmed by the histories detailed of "dissecting aneurisms," which indicate that, even when ulceration or rupture exists in the internal and middle coats of diseased arteries, the external coat may retain sufficient strength to resist the formation of a proper aneurism.

Although these occasional causes are frequently operative, nevertheless, aneurisms often form when no immediate or exciting cause has been, or could be, detected, and the explanation, from the facts presented, is easy. Ulceration in the internal or middle coats results from the chronic inflammation, and often as a consequent of the cheesy or calcareous deposits in or between these tissues; or, perhaps, as supposed by Corvisart, a steatomatous cyst, by the process of development and ulceration, opens into an artery, and its contents being gradually removed by absorption, or by the current of blood, the cyst becomes distended. In some instances, however, there is no solution of continuity, but all the tunics are gradually dilated by the *vis a tergo*, forming the "true aneurism" of authors. As to the relative frequency of the three modes by which aneurisms commence, *dilatation*, *ulceration*, and *rupture*, much has been written, but little can be positively known, as these tumours are seldom examined in their early stages, and the subsequent changes are so similar that the original condition of the tissues cannot be positively determined. It is probable, however, that ulceration of the internal and fibrous coats occurs more frequently than rupture, and that dilatation of these membranes is comparatively rare.

Formation and Progress of Aneurisms. The circulation of the blood is effected, not by any inherent powers in this fluid, but by exterior agents, as, the heart, arteries, &c. (Vide *Circulation.*) The blood, therefore, is altogether passive, and, so long as motion is continued, it remains fluid, but when almost or altogether at rest, it speedily coagulates, and this more rapidly in dead, than in living tubes. Hence, when any particles of blood are arrested by an irregular surface, as from rupture or ulceration, or fungous growth, on the inside of an artery, such particles coagulate, their serous portions escaping. These coagula serve to entangle other portions of blood, so that the mass increases. Hence, also, if blood be driven out of the general course of the circulation, into any *cul de sac* or cavity, coagulation necessarily ensues. Again; whatever may be the influence of the arteries over the circulation of the blood, none will deny that there exists a constant pressure of the blood against the parietes of the arterial tubes, and a proportioned resistance by the walls of the vessels, and that this action and reaction are increased by every cause which augments the momentum of blood, and diminished whenever this momentum is lessened. It has already been shown, and it is a subject of hourly experience, that this action and reaction are so nearly proportioned, in a state of health, that neither predominates;—the artery is not preternaturally dilated by the momentum of the blood, or inordinately contracted from the excess of reaction: and still further, that even when the external coat of a healthy artery is injured by wounds or ulceration, or when there is a solution of continuity in the internal and middle coats, there is no dilatation of the remaining coat, from any momentum which the blood ever acquires during health. In case, however, of disease of the arteries, such as has been described, in which their strength, vital or physical, is impaired, and especially when there is also a solution of continuity in the internal tissues, the action and reaction are no longer balanced, the weakened spot yields to the momentum of the blood, and being continually impinged upon by this fluid, gradually enlarges until a perfect aneurismal tumour is formed. The formation, therefore, of the swelling, depends on a disproportion between the strength of the

diseased spot in the arterial tunics, and the momentum of the blood. This momentum may therefore be regarded as the *essential* or *proximate* cause of aneurism; the predisposition depending essentially on the morbid condition described.

When there is no solution of continuity in the internal coats, the tumour communicates by a larger orifice with the artery than when rupture or ulceration had previously occurred; in which case, the orifice is more contracted and irregular. It is also found that the coagulum which first forms is usually near the circumference, as the blood is there less under the influence of the momentum, and comparatively at rest.

Being thus formed, the aneurism enlarges under the continued influence of the proximate cause, until the resistance of the distended tissues is so great as to prevent further dilatation. At this period, aneurisms often remain stationary, until other changes ensue. The distension of the tissues, and perhaps other causes, excite a more active inflammation in the parietes of the tumour, which is manifested by their increased thickness and firmness, and by the close vital adhesion between the external coat of the aneurism and the surrounding tissues. The induration extends to the edges of the orifice in the artery, preventing, for a long time, the enlargement of this opening, and causing the sides of the vessel to appear as an imperfect partition between the cavity of the vessel and that of the sac. The lips of the orifice, in such cases, are usually thickened, smooth, and regular. (GUTHRIE, p. 55.)

The degree of irritation is generally so great in some portions of the tumour as to transcend the adhesive stage of inflammation, and excite ulceration. This is manifested on the most prominent part of the swelling, and on its internal surface. Hence, should the internal and middle coats be dilated at the formation of the aneurism, they soon disappear at the apex, and even on the sides of the swelling, under the combined influence of distension and ulceration, so that in nearly every aneurism of moderate size, these tissues either cannot be traced, or have a reticulated, honey-comb appearance, especially where preternatural calcareous or steatomatous formations have existed. To use the language of authors, "true aneurisms" are thus converted into "false consecutive aneurisms," or "external mixt aneurisms;" a change, however, not to be ascertained during life, but by the knife of the dissector alone, and hence ought not to be assumed as the foundation of a practical division of aneurisms. The ulcerative process, however, is not confined to the internal tunics of the artery, although in these it occurs speedily; but, after some delay, extends also to the external coat, which is perforated, and more or less extensively destroyed, so that the blood would be effused into the cellular sheath, if adhesion of the artery to this tissue had not already occurred. The sheath now forms part of the sac, but, in its turn, ulcerates, without, however, being followed by effusion, for the ulcerative inflammation is very generally preceded by adhesion, so that the superincumbent tissues become, in succession, adherent and thickened, prior to ulceration. Thus the blood is always contained in a circumscribed sac formed of the remains of the arterial and other tissues which have, at any time, contributed to its formation, as well as by those which have not been yet subjected to the ulcerative process. In this way, each tissue is successively perforated, not excepting fasciæ, cartilages, and bones, until the aneurism has reached an external surface, whether cutaneous or mucous. If ulceration continue, the cavity will be opened, and the blood be effused, causing the destruction of the patient. This seems sometimes to be the case, but in most instances, when the parietes are much thinned, rupture ensues, from some sudden muscular exertion, or disturbance of the circulation of the blood. But rupture, and even ulceration, are usually preceded by the formation of a slough, from the distension which these exterior tissues experience, and the interruption, of course, to their organic actions.

Although the ulcerative inflammation is usually preceded by the adhesive, yet this is not universally the case, either from the great degree of irritation existing, or from the relative position of the tissues not admitting of adhesion. In such cases, effusion into serous cavities, or into the cellular tissue, occurs, by which death is caused, not always immediately, but very speedily. Thus, aneurisms of the aorta may, and often do, open into the pericardium or pleura, or into the cellular tissue of the superior or posterior mediastinum.

The enlargement of an aneurism, its advance to the surface, and its rupture, are dependent, therefore, on two general causes, mechanical distension from the momentum of the blood, and the ulcerative inflammation excited by this distension. Neither of these causes would alone be adequate, as no dilatation occurs when the

influence of the blood is removed; and distension, without ulceration, would continually be more difficult, as tissue after tissue is applied to the walls of the aneurism, so that eventually the resistance would predominate and the enlargement cease. This would especially be the case when fasciæ and bones were involved. By absorption, however, the tissues which were at first thickened by the adhesive inflammation, become thinned and removed; the resistance is thus lessened, and the aneurism advances more rapidly to a fatal termination in the latter than in the earlier stages of the affection.

Spontaneous Cures. Aneurisms do not, however, always terminate fatally. They are sometimes arrested in their progress, remaining stationary for years, and sometimes are completely cured, by the operation of natural causes. These causes must be investigated, that their influence may be assisted, and not retarded, by the agency of the surgeon.

Formation of Coagula. Dissection has demonstrated that as aneurismal swellings enlarge, dense laminated coagula form in their cavities, the central portions being occupied by fluid blood; and also, that the arterial tissues are, during this enlargement, thickened by the adhesive inflammation, and united firmly to the superincumbent tissues of every kind. The distension and progress of aneurisms are, therefore, resisted by three important obstacles, *the laminated coagula of blood, the arterial, cellular and other incumbent tissues*, and finally, *the induration of these tissues.* Generally, these resistances fail, in consequence of the inflammation transcending the adhesive stage and passing on to the stage of ulceration; but dissection has shown that, occasionally, the balance between the resistance of the parietes of the tumour and the momentum of the blood, is restored, either from an increase of the resistance, in the manner alluded to, or from a diminution in the force of the circulation, or from both causes conjoined. In such cases, the tumour either remains stationary or becomes obliterated. The process of cure seems to be as follows: When no ulceration ensues, or when it has ceased, and when the momentum of the circulation is moderate, the density of the sac increases from the adhesive inflammation, and the coagula become so numerous and firm as eventually to occupy the entire cavity of the aneurism, and prevent any influence from the momentum of the blood on its parietes. If any pulsation be now perceptible, it resembles that of tumours connected with arteries, being simply elevating, not excentric or expanding. But the coagulation of blood is not usually confined to the sac, but, in arteries of the second and third magnitude, extends into the vessel for some distance, generally to the first collateral branches above and below the aneurism, occupying the whole cavity of the vessel, and obstructing the course of the blood. The case already quoted from Sir A. Cooper, of the femoral artery being partially closed, the blood passing through a canal in the coagula, is an exception to this remark; as also the case from MM. Marjolin and Bérard. In arteries, however, of the first magnitude, particularly the aorta, Mr. Hodgson has clearly shown that the passage of blood into the sac may be completely closed by coagula, and yet the caliber of the vessel remain unobstructed. (See the account of dissections above given.)

By the formation, therefore, of coagula in the sac, and sometimes in the artery, the first stage of the cure is accomplished, in the same way as the temporary arrest of hemorrhage is effected by the external and internal coagula of blood. (Vide *Hemorrhage.*) But here, as in wounded arteries, the permanent cure is the result of the adhesive inflammation and of interstitial absorption. The coagula of blood, by absorption are rendered more dense, and finally are removed. The parietes of the sac of the vessel become more thickened and indurated, contracting in proportion as the coagula are diminished, so that eventually the artery appears as a ligamentous cord, and the sac as a small indurated tumour attached to the cord, the remains of the artery. These changes are revealed on dissection, in cases of spontaneous cures, and also where recoveries have resulted from the interference of the surgeon.

In aneurism of the aorta, when the patient has recovered, and the artery remained pervious, subsequent dissection has fully demonstrated that the first or temporary stage of the cure has been effected, but the permanent cure, by the complete obliteration of the tumour in consequence of the absorption of the coagula and condensation of the sac, has not yet been satisfactorily exhibited, although there can be little doubt of its occurrence in some cases. If the tumour described by Hodgson, on the cerebral artery of a lunatic, was, in reality, a case of aneurism, it exhibits not only an example of a cure nearly complete, but also a proof that this mode of recovery can occur in aneurisms of even

small arteries, without obliteration of the vessel. The dissections recorded by Corvisart are probably specimens of the remains of aortic aneurisms, in which there occurred, not only the destruction of all the symptoms, by the formation of the coagula and condensation of the tumour, but also the closure of the orifice communicating with the artery, by a new adventitious membrane.

In all cases of spontaneous cures as above effected, there must be some change in the diseased actions of the arterial tissues, the foundation of the aneurism, as, otherwise, the tumour would either continue to increase by ulceration, or would speedily be reproduced, the causes continuing operative.

The above may be regarded as the natural mode by which aneurisms are cured; but there are other modes which may be considered accidental, depending on peculiar circumstances.

Compression on the aneurismal artery. As the tumour enlarges, it might be supposed that some degree of pressure would be made on the artery with which it is connected, especially when its development is resisted by fasciæ, bones, &c. This, however, rarely occurs, probably from the fact that the distending force is from within the artery and sac. The aneurismal swelling is, however, occasionally driven downwards by the force of the circulation, so that the communicating orifice is nearer the superior than the inferior extremity of the tumour, and there is reason to believe that, in some instances, by the pressure of the tumour, the cavity of the vessel has been obliterated and the aneurism cured. This has not, however, been proved by dissection; indeed, it would be difficult to show, by the knife, whether a particular case of obliteration and cure was the result of coagulation of blood, followed by adhesion and absorption, or whether the adhesion occurred at once, as the result of pressure. Mr. Guthrie asserts that pressure is a probable cause, but as yet not supported by positive dissections: he, however, notices many examples, as already intimated, of closure of the inferior portion of the artery, while the blood entered the sac freely from the artery above. The obliteration must have been owing to the adhesive inflammation, and this was probably excited by the pressure of the tumour, in the same way that inflammation is excited in the superincumbent tissues. Scarpa and Sir E. Home believed that obliteration of the artery occurred frequently in this way: they, however, cite no cases. MM. Marjolin and Bérard agree with Guthrie, that however theoretically true, this fact is not demonstrated; these gentlemen believing that the following case cited by Hodgson as a recovery from the pressure of the tumour on the artery, was not satisfactory. In this case, an aneurismal tumour of the femoral artery, about four inches below Poupart's ligament, was treated by compresses, and by a bandage extending from the foot to the groin, for some months, when suddenly the whole limb became extremely cold and benumbed, and the tumour and thigh livid. The next morning, the pulsation of the tumour ceased: soon the warmth returned, and the tumour diminished in size. For twelve years the patient remained well, the upper part of the thigh being larger than natural. The tumour again increased, but very slowly, for eight or ten years, without any signs of aneurism. The apex eventually sloughed, and brown sordes, with lamellated coagula, were evacuated. There was no hemorrhage, but death ensued from the irritation and fever. On dissection, the artery was found obliterated for the space of three inches, the surface of the sac was in a sloughing condition, but no large blood-vessel communicated with its cavity. "The body of the sac was reflected upwards upon the obliterated portion of the artery. Below the obliterated part, the coats of the artery were remarkably diseased, and were dilated into a small sac in the ham. It appears probable that the cure of the aneurism was the consequence of the obliteration of the upper part of the artery, which was compressed between the tumour and the femur." p. 109, 110. We agree with Mr. H. in this conclusion, and believe that in consequence of the pressure of the tumour, the adhesive inflammation, which, from this cause, always exists in the parietes of the sac, is often propagated to the aneurismal artery; but, for reasons already given, this cannot be readily demonstrated by dissection. It is confirmed by the acknowledged fact that pressure of the tumour frequently causes the obliteration of contiguous arteries.

Acute Inflammation, Suppuration, and Sphacelation, form another mode by which aneurisms have been destroyed, but not without great danger to the patient.

This inflammation generally arises from causes unconnected with the aneurism, such as contusions, wounds, depraved conditions of the general system, or of the chylopoietic viscera, &c. It involves the surrounding tissues, and usually terminates in gangrene and sphacelus, necessarily fol-

lowed by extensive sloughing. By the severity of the irritation, the profuseness of the suppuration, or the occurrence of hemorrhage, the life of the patient is frequently destroyed. Should he fortunately survive, the tumour sloughs away, dangerous hemorrhage being prevented, as in ordinary cases of mortification, by the formation of coagula in the artery, followed by the condensation and obliteration of the vessel. Granulations form, and cicatrization of the extensive ulcer ensues. Cases exemplifying these changes are recorded by most writers on aneurism. In some instances, there is little sloughing, but suppuration occurs in the cavity and walls of the tumour, which is eventually evacuated by ulceration, often followed by hemorrhage and the death of the patient. Sometimes the cavity of the vessel may be occupied by coagula, in which case, the patient may survive, being merely subjected to the dangers of an ulcerated sanguineous abscess.

Effects on other tissues and organs. During the progress of aneurisms, many inconveniences and dangers result from their interfering with the functions of important and even vital organs, varying according to the nature of the organ, the location of the aneurism, its size, and the rapidity of its development. These will be noticed when treating of individual aneurisms. It may be remarked, at present, that the most common danger is from interruption of the circulation of the blood, caused partly by the swelling, and partly by the diseased state of the vessel. There is hence a disposition to venous engorgement and œdema; or the parts are cold, livid, and torpid. When the impediment is great, and especially when the blood is completely excluded from the main trunk, the lividity, numbness, and coldness, often increase, and sometimes very suddenly, from the deficient supply of blood; they are occasionally the precursors of gangrene, particularly when the fasciæ and skin are tense, and the nerves, veins, and collateral arteries, compressed by the size of the tumour. Should this accident not occur, the collateral circulation becomes gradually established, in the order already detailed, the capillary and anastomotic vessels being developed in proportion to the obstruction in the main artery.

From the preceding investigation, the following corollaries may be deduced as the foundation of our prognosis and treatment in spontaneous aneurisms.

1. The *preternatural enlargement* or *dilatation of arteries* differs from proper aneurisms, because the enlargement extends to the whole circumference of the vessel, is spindle-shaped, and communicates freely, and not by a small or comparatively contracted orifice, with the cavity of the vessel. Coagulation of blood, therefore, rarely occurs, perhaps never, unless the internal coat be ruptured or ulcerated, and then the coagulum is uniform, not lamellated. There is comparatively little disposition to increase; it is often stationary for years, and not unfrequently is dissipated. In both diseases, however, there is a similar alteration of tissue, and hence, aneurisms are frequently grafted on dilated arteries.

2. Spontaneous aneurisms are never formed in healthy arteries, even when there is a solution of continuity in the external coat, or in the internal and middle coats. Neither of the tunics becomes dilated by the *vis a tergo*, but it is thickened and indurated by the adhesive inflammation. "Hernia of the arteries" does not, therefore, ensue from a wound of the external or cellular coat.

3. The predisposing or essential cause of aneurism consists in a morbid state of the artery, the result of chronic inflammation; by which the physical and vital strength of the vessel is impaired, there being a diminution of the elasticity and tonicity of a portion of its parietes.

4. This predisposition is increased by contusions, wounds, ruptures, or ulcerations, interesting one or more of the coats of the vessel; also, by the curves and divisions of the arteries, by proximity to the heart, hypertrophy of this organ, or any other cause of increased momentum to the circulation. Hence, many of these circumstances are also exciting causes of aneurism.

5. The immediate, determining, or proximate cause of aneurism is the *vis a tergo*, the momentum acquired by the blood, acting on a weakened portion of the arterial tunics. There is, therefore, a loss of balance between the momentum of the blood and the resistance of the arterial tissues; the latter being always diminished, as simple increased momentum will not alone excite an aneurismal swelling.

6. The formation and progress of an aneurism depend, therefore, on the impetus of the blood; this being removed, the disease disappears. But this impetus is not alone sufficient, at least in all cases, for the continued increase of the tumour; its influence is augmented by the ulcerative inflammation in the parietes of the tumour and the surrounding tissues, arising

in some degree from the original morbid condition of the vessel, but chiefly from the pressure of the swelling. The ulceration commences on the internal surface of the sac, and extends through the several tissues, until the blood is effused upon an external surface or into a serous cavity, causing the death of the patient.

7. Spontaneous cures of aneurism arise from the cessation or diminution of the *vis a tergo*, and increased resistance in the walls of the sac. The resistance is augmented by the formation of dense lamellated coagula, filling the sac, by the accumulation of tissues on the tumour as it enlarges, and, by agglutination and thickening from the adhesive inflammation. If, therefore, the impetus of the blood be removed, the disease ceases; and in some cases, when the impetus of the blood is moderate, a cure results from the accumulated resistance, provided the original disease of the artery, and the ulcerative inflammation, be subdued. The progress of the aneurism being arrested, the obliteration of the tumour follows, from absorption of the coagula and the contraction and eventual absorption of the sac. Sometimes, suppuration, and even sloughing, occur, by which the tumour is destroyed, after the artery is obliterated.

8. Other spontaneous modes of recovery by inflammation, sloughing, &c., are accidental, and accompanied by much danger.

9. When an artery is obstructed, a collateral circulation is soon established through its larger branches and their anastomosing ramifications. These vessels are usually much developed during the progress of the aneurism and before obstruction in the artery has occurred; the development occurring primarily and speedily in the capillary vessels, then in the anastomotic vessels, and finally, in the collateral branches. Eventually, one or two of the larger communicating vessels remain permanently developed, and the remainder return to their natural or original condition.

10. The establishment of this collateral circulation is impeded or prevented by external pressure, or by the distension of the skin, fasciæ, &c. from the enlargement of the swelling, especially in confined situations; in all of which cases there is imminent danger of mortification.

Prognosis. The deductions from the above history exhibit the dangerous character of even the simplest form of aneurism, and *à fortiori* of its various complications. These dangers are numerous, and it will be useful to state some of them more distinctly.

1. The diseased condition of the artery at and near the aneurism, and the not unfrequent extension of this state to other and distant vessels, rendering the patient liable to a recurrence of the complaint, and often baffling the best devised modes of relief. Hence, also, the coexistence of different aneurisms, either in the same or in distant vessels, of internal and external aneurisms.

2. The very general occurrence of the ulcerative inflammation in the parietes of the sac, often assuming the phagedenic character, so that the tumour enlarges rapidly, and not unfrequently effuses its contents into cellular, serous, or other cavities, causing the death of the patient.

3. The occurrence of the suppurative and gangrenous inflammation in the parietes of the sac and the surrounding tissues, endangering life not only by the severity of the irritation, and the extent of the abscess and sloughs, but chiefly by the liability to hemorrhage, and also by the increase of irritation and suppuration from the presence of putrefying coagula of blood.

4. Mortification, without inflammation, in the parts beyond the aneurism, from the sudden obliteration of the main trunk before the collateral vessels are sufficiently developed; or from the anastomotic and collateral circulation not being established, in consequence of external pressure, of the great size of the swelling rendering the skin and fasciæ very tense, of want of development and activity in the capillary and smaller arteries, as in old persons, of wounds or obliterations of the venous trunks, of injury or paralytic condition of the nerves, &c.

5. Great irritability of the cerebro-spinal nervous system; of the organic and general circulation; disorders of the chylopoietic viscera; the existence of a scorbutic, scrofulous, syphilitic, mercurial, arthritic, or other cachectic diathesis. Under all these circumstances, the local irritation and disease are aggravated, and the aneurism advances with more than its wonted rapidity.

A more favourable prognosis may be made when the aneurism occurs in young persons, free from natural or acquired morbid predispositions, with a healthy condition of the important viscera of the head and trunk, where the circulation is moderate, and where there is little local irritation. Even, however, in such cases, the ready occurrence of ulceration will very

universally insure a fatal termination at no very distant period, unless an appeal be made to the resources of the profession, which, fortunately, are abundant, and frequently efficacious.

Indications for the treatment of aneurisms, derived from the pathological facts and opinions already stated, are few and simple.

1. Destroy, if possible, the *vis a tergo*, the impetus of the blood against the weakened and diseased portions of the artery, as this is the essential or immediate cause of aneurism.

2. If the above indication cannot be fulfilled, moderate, by suitable measures, the force of the circulation in the affected artery and in the aneurismal sac.

3. Subdue, or at least diminish, the original disease in the arterial tunics, and prevent or arrest the ulcerative, suppurative, or gangrenous inflammation in the parietes of the sac.

If the first indication be fulfilled, and the blood be entirely excluded from the aneurismal artery, coagulation in the sac and artery necessarily ensues, followed by absorption of the coagula, and by condensation and obliteration of the sac and artery, in the manner already explained under the head of *Spontaneous Cures*. The complete exclusion of the blood can only be effected by surgical means, and in external aneurisms.

In internal aneurisms, and in all cases where surgical measures are forbidden, the two remaining indications are to be fulfilled as far as possible, so as to favour the spontaneous or natural mode of recovery by coagulation of the blood, and by condensation and contraction of the walls of the sac and artery. These objects may be effected by *medical measures* acting on the general circulation and on the diseased tissues.

Hence, the treatment of spontaneous aneurisms must be noticed under two grand divisions, *Medical*, and *Surgical;* the former but too often palliative, the latter, to the credit of modern surgery, very generally successful.

Medical Treatment. This is to be instituted for the fulfilment of the second and third indications; and fortunately, the same measures calculated to diminish the momentum of the blood, are the most suitable for arresting or diminishing the local irritation. These measures are generally known by the term "*antiphlogistic*," and are considered, as general and local, as being addressed more directly to the general or local circulation.

General measures include everything which diminishes inordinate arterial excitement, especially blood-letting, refrigerants, digitalis, purgatives, diaphoretics, perfect quietude of body and mind, and an abstemious diet. Their employment was suggested by the evident connexion between the force of the aneurismal pulsations and the activity of the circulation; but it first occurred to Valsalva and Albertini, then students of medicine in Italy, as we are informed by Morgagni, that a radical cure might be effected by reducing the force of the circulation to a degree barely compatible with the continuance of life. With this object, Valsalva confined his patients to bed, removed every moral and physical stimulus; bled them at first freely, afterwards more moderately, as the strength was diminished; and restricted their food and drink, in quantity and quality, until they were so reduced as to be unable to raise an arm from the pillow, or to turn in bed. For weeks, they were kept on four to twelve ounces of solid food, and eight ounces of pure water, *per diem.* When the symptoms were much moderated, a very gradual addition was made in the quantity, and then, in the quality, of the ingesta; but the same system was persevered in, until the disease was entirely subdued, when the patient was very gradually restored to his accustomed diet and engagements.

That Valsalva and Albertini were occasionally successful in effecting permanent cures, can no longer be doubted, as the practice has been adopted with varying degrees of success, and recommended by Morgagni, Lancisi, Guattani, Corvisart, Sabatier, Pelletan, Boyer, Hodgson, and other distinguished surgeons. Pelletan (*Clinique Chirurgicale*, Tom. 1.) details fourteen cases which were either ameliorated or permanently cured. The practice is supported by the pathology of aneurism, and is efficacious, not solely, as has been supposed, by diminishing the force of the circulation, and thus facilitating the coagulation of blood in the sac and artery (the spontaneous mode of cure), but also, by preventing or subduing the ulcerative inflammation in the walls of the tumour, which so powerfully contributes to the progress of aneurisms; and perhaps by eradicating the original chronic disease of the artery.

Being supported, therefore, by theory and experience, the evacuating treatment should be recommended in suitable cases; but the extent to which it may be carried, must be regulated by the soundest judg-

ment and the most ample experience; for there is danger that the patient might perish from the degree of exhaustion, even when the symptoms of disease had vanished; and in all cases, the system becomes excessively irritable, for, as strength diminishes, irritability increases. Hence, the least mental agitation or physical disturbance often excites violent and irregular pulsations of the heart and arteries, and may induce a febrile irritation, speedily followed by collapse and death. The existence, also, of any local chronic disease, trifling in itself, and innoxious in the plenitude of the patient's strength, will, when his system is thus weakened and irritable, cause a nervous or vascular excitation, not to be controlled by medical measures, and usually terminating fatally in a short period. Should these dangers be avoided, another difficulty occurs when patients have been much exhausted by bleeding, diet, &c.; the blood becomes very thin, the coagulable portions nearly disappear: hence, even when the momentum is sufficiently diminished, and the ulcerative inflammation arrested, no cure may result, as few or no coagula form from this serous blood in the sac and artery. As soon, therefore, as the circulation is allowed to increase, the symptoms return, and often the aneurism enlarges with more than its former rapidity, as the irritability of the tissues is greater, and their strength diminished, by the exhausting measures adopted. Ulceration and distension occur under such circumstances more readily. M. Dupuytren has also observed that the action of the heart is diminished in a less proportion than the resistance of the walls of the tumour. When nourishment, therefore, is administered, the original disproportion between the momentum and the resistance is aggravated, of course with increase of the disease.

Valsalva's treatment must therefore be regarded as in itself dangerous, and always uncertain in its results, especially when there is a previous cachectic condition of the general system, or any local chronic disease in any important organ. In such cases, it should be forbidden, and should never be substituted for surgical measures, when these are practicable. In internal aneurisms, however, where an operation is impossible, and where, as appears from the history given of the progress of the disease, a fatal result almost universally ensues if no assistance be afforded, it should, as a general rule, be adopted in conjunction with the local measures presently to be mentioned, and carried as far as compatible with the safety of the patient. It is the least danger, and the opportunity of recovery should be afforded the unfortunate sufferer. The declaration of Mr. Hodgson, "that in most of the cases of spontaneous cures" (so called) which he details, "this debilitating treatment had been fully enacted," is very encouraging for patient and practitioner.

As a *palliative* measure, the evacuating treatment, when moderately enforced, will be found very useful in ameliorating distressing symptoms, contributing to the comfort of the patient, and retarding the progress of the disease. Even in external aneurisms, it is sometimes requisite in preparing the system for suitable operations, and in facilitating directly some of the surgical forms of relief.

Respecting the mode of abstracting blood, Mr. Hodgson cautions against producing fainting in aneurisms of the aorta, as, during that state, blood might so accumulate in the sac as to form an impediment to the circulation when the heart revives. He has known much alarm excited under such circumstances, and Morgagni mentions an instance in which it terminated in death. The former advises that the bleedings be small in quantity, and frequently repeated, and that the blood should flow in a small stream.

Local measures render the above practice more efficient, and at the same time safer. They comprise most of the local antiphlogistic remedies. More especially have leeches, astringent and cooling lotions, snow and ice, been recommended by experienced surgeons, some of whom have attributed recoveries from aneurism entirely to their influence. Authors regard them as effectual, simply by diminishing the momentum of the blood in the artery and tumour; but, if the views now presented be correct, their influence must chiefly depend on their preventing or subduing the ulcerative inflammation in the sac, and in arresting the original morbid irritation of the arterial tunics. Considered in this light, they must be very important, and should be employed much more extensively and methodically than they have ever yet been, as facilitating, in a most direct manner, the natural mode of recovery. (Vide *corollary* 7.) By resorting also to local measures, less injury is inflicted on the constitution of the patient, and the general remedies need not be carried to the same extent.

Leeches and *cold astringent* applications are the most efficacious of these mea-

sures. The former should be frequently repeated along the course of the artery, and near the tumour, and the latter be continually applied over and around the aneurism. The degree of cold must depend on the sensations of the patient, and on its effects. Snow or ice has often been tolerated, and has effected recoveries in a few months; but sometimes, says Mr. Hodgson, it cannot be endured. Cooling or evaporating lotions should then be substituted.

Blisters have not been much, if at all, used, but, at appropriate stages of the complaint, might act beneficially as *revulsives*, and should therefore never be applied directly over the sac.

Moxas may be useful, on the same principle. They have been recommended and used in many instances with advantage, by Baron Larrey, after the application of leeches; but the idea of applying the actual or potential cautery to the aneurismal swelling, to destroy it, at once, by sphacelation, as employed by M. Severin, cannot be justified. It deserves universal reprobation, for no man can, *à priori*, determine the extent to which the sphacelation would extend, or whether hemorrhage would, or would not, result, on the detachment of the sloughs. A cure by this process is barely possible, but death, by irritation or hemorrhage, almost inevitable.

In all attempts to effect a radical cure by medical measures, perfect quietude is essential for success. Muscular action should be suspended, as much as possible, for obvious reasons. Hence, patients should be strictly confined to bed; and in aneurismal swelling about the shoulders, groins, and especially in the extremities, this suspension of motion may be rendered more perfect by the judicious use of splints, so as to prevent all action in the muscles in the neighbourhood of the tumour, and even the involuntary flexure of the joints, that the affected artery may also be at perfect rest, excepting so far as the circulation is concerned. Such splints must be so constructed and applied as not to exert any improper pressure on the limb, impeding the collateral circulation.

The idea has been suggested of facilitating the coagulation of the blood in the sac, by means acting on the blood. None, however, have been proposed, which are at all feasible. Some have thought that the internal use of the *mineral acids* had an influence in this way; and it has been recently suggested to try the effect of *galvanism*, and also to introduce a long, sharp needle some distance into the sac, and to heat its outer extremity, under the idea that the *caloric* conveyed along the needle would cause coagulation in the sac. Such suggestions as this last, indicate much ignorance or rashness.

Surgical Treatment. As so little benefit can be anticipated from medical means, surgical measures should be almost universally adopted in the management of external aneurisms. Their object is the fulfilment of the first indication, to destroy the *vis a tergo*, at once, or at least to moderate the force of the circulation to such an extent that a radical cure, by coagulation and absorption of the blood, with condensation and obliteration of the sac and artery, may result. In both cases, when the impetus of the blood is completely arrested, or when it is merely moderated, assistance will be derived from a judicious resort to some of the medical measures already detailed.

It may be remarked, that a surgeon is not justified, in a disease having the fatal tendency of aneurism, in adopting any measures merely palliative, or which will only occasionally effect a permanent cure, when more efficient means are at his command. These should always be immediately employed; but when, through the timidity or obstinacy of the patient, or from the attending circumstances, they are inapplicable, the practitioner should employ other more doubtful remedies, in the most effectual manner.

The surgical treatment of aneurism is included under the general denomination of pressure, which may be made to the aneurismal tumour, to the artery above or below the tumour, or to the whole limb, and may be effected by compresses and bandages of various materials and forms, or by ligatures on the artery. This last measure is so much more effectual and safe than any other mode, that it is the usual resort of the surgeon, and is emphatically termed, *the operation* for aneurism.

1. *Compression on the Tumour.* This was one of the earliest suggestions, and was generally made by means of graduated compresses, applied on the swelling, and secured by bandages around the limb. Experience soon demonstrated its inefficiency and its dangerous tendencies. The dressings were easily deranged, the momentum of blood in the artery was but slightly influenced, engorgement of the veins and infiltration of the cellular tissue below the part ensued, pain was severe from pressure on the nerves, and the compression, when so great as to arrest the

circulation in the tumour and artery (in which case alone it could effect a cure), could not be tolerated, and often excited symptoms of heat and irritation in the tumour, so that the progress of the disease was accelerated. Notwithstanding, therefore, ingenious attempts to obviate these dangers by the mode of applying pressure, this method has been very universally abandoned.

2. *Compression on the whole limb* was speedily suggested as a substitute for the above method, over which it possesses considerable advantages, and was formerly resorted to with much confidence and reputed success. It is best effected by graduated compresses over the aneurism, and a long, narrow, but firm, compress over the artery above the tumour, to be secured by a roller firmly applied, *secundum artem*, from the very extremity of the toes or fingers, and extending beyond the disease to the body; the axilla or groin being covered by turns in the form of the "spica bandage." It will usually be requisite to bandage the fingers or toes separately, by a narrow roller, previously to the application of the long roller to the limb.

When this bandage is assisted by rest, and the evacuating treatment, cures may occasionally be effected, as, by it, the tumour is partially emptied and compressed, the impetus of blood is resisted not only in the tumour, but also in the artery; coagulation of blood is thus facilitated in the sac and vessel, while engorgement and œdema below the aneurism are prevented by the bandage extending to the extreme parts of the limb, and the pain is more tolerable than when the tumour alone is compressed.

The disadvantages and dangers are, however, great. Few individuals will submit to the uneasiness and pain which usually ensue, and the dressings become loose from the stretching of the bandages, the emaciation of the limb, or even the restlessness of the patient, and must, therefore, be renewed. During their relaxation and renewal, the good effects are often lost, from a return of the blood, the displacement of coagula, &c. Finally, the establishment of the collateral circulation is seriously impeded, so that should the main trunk be obstructed, and the curative process be actually commenced, mortification (usually, the dry mortification) would often ensue. Hence, it is in some respects a dangerous measure, and should seldom be recommended. In advanced cases of aneurism, when the skin becomes inflamed, it should always be positively forbidden.

3. *Compression above the tumour.* Since such great success has attended the application of a ligature to the artery between the sac and the heart, surgeons have been more intent on the idea of attaining, by external pressure on the artery, the good effects derived from the ligature, and thus avoiding the pain of the incision, and the irritation from the application and retention of a ligature on a large artery. It was thought that by pressure, the internal coats of the artery being brought into contact, and so retained, would adhere; that thus the vessel would be obliterated, coagulation of blood in the tumour ensue, and the disease be cured. Others, less sanguine, imagined that pressure above the sac would merely diminish the momentum of the blood so as to facilitate the formation of the laminated coagula in the sac.

In fulfilling this design, the ingenuity of surgeons has been taxed to devise a mode of applying pressure on the artery alone, leaving all other portions of the limb free, so that the collateral circulation shall not be interrupted, nor engorgement of the limb be produced. One of the most simple and perhaps effectual measures proposed, is to place a high graduated compress over the artery, and a broad and thick compress on the opposite part of the limb. These compresses are to support a circle of steel of sufficient firmness and elasticity, the extremities of which are thinned and pass each other, being connected not by rivets, but simply by a ring or slider, so as to prevent lateral motion. A common tourniquet (that of Petit) passed over this steel circle, would, when tightened, press merely on the points under the compresses, and thus allow the collateral vessels to enlarge. A more recent method has been adopted, if not proposed, by Dupuytren, and is almost exclusively, says Begin, employed in France. The compressor of Dupuytren consists of a semicircle of solid steel, having, at one extremity, a large concave cushion adapted to the posterior part of the limb opposite to the artery, and, at the other extremity, a pad which can be brought near to the cushion, or removed, by means of a spiral spring and screw. The pad is to be applied over the artery, so that by turning the screw, pressure is made to the requisite degree, and of course confined to the two opposing points of the limb under the cushion and pad. This mode of compression is preferable to those already detailed, as the steel elastic spring preserves a uniform pressure during the movements of the limb and during the progress of emaciation; it allows, and even, by impeding

or preventing the course of the blood in the main trunk, facilitates the development of the anastomosing and collateral vessels; and the tumour is free, so that astringent and cooling lotions, and other suitable measures, can be simultaneously employed.

Nevertheless, great difficulties exist in the effectual employment of any compressor of the artery. The instrument is very apt to be deranged, and is often ineffectual, as no point of resistance is usually afforded, excepting perhaps where the subclavian artery passes over the first rib, or the femoral artery over the pubis; and as the pressure is also made on the nerve and vein accompanying the artery, the pain is usually too great for endurance, and engorgement and infiltration in the parts below, must inevitably ensue. From the degree of compression employed, inflammation and ulceration of the skin are frequently produced, and sometimes even arteritis, phlebitis, or neuritis excited; aggravating excessively the dangers incurred, especially when, from the location of the aneurism, the pressure must be made near the tumour, and of course on a diseased portion of the vessel. Experience confirms these observations; for although M. Freer has by pressure externally on the arteries of a horse, excited inflammation and obliteration of the tube, in four days, and recoveries from aneurism in the human subject have followed this mode of treatment, yet, says M. Begin, these are few compared with the failures, and have always been obtained at the expense of much suffering, agitation, and danger, and as the result of a tedious and uncertain experiment. The difficulties, he observes, are inherent to this mode of management, and cannot be obviated by any instrument. Compression on the artery, when moderate, may, however, be occasionally useful, prior to the application of a ligature to the artery, in promoting the collateral circulation; and in all attempts to effect the radical cure of external aneurism by medical measures, some advantage may result by thus diminishing the flow of blood in the affected artery, provided no engorgement of the veins, and no severe pain, be produced.

4. *Compression below the tumour* has also been proposed. It is, however, liable to the objections already detailed, and, moreover, involves the difficulties and dangers incident to the application of a ligature below the tumour, and which will be presently mentioned. There is reason to believe, that in all cases, it would not only be ineffectual, but even that it would aggravate the symptoms. M. Vernet adopted this plan in a case of inguinal aneurism; but the pulsations were so increased, and the inconvenience so great, that it had to be abandoned. "This," says Begin, "is the invariable result, and this measure is justly proscribed in the practice of enlightened surgeons, who believe that recourse should not be had incessantly to experiments already made, and that science ought not to be every day recommenced by renewing projects which she has rejected."

5. *Compression, immediate.* The above described methods have, by systematic writers, been termed *mediate*, as distinguished from pressure made directly on an exposed artery, or on the open orifices of the vessel in a ruptured or incised sac, and hence termed *immediate.*

Before the present improved methods of treatment were instituted, it was recommended to lay open the aneurismal sac, remove the coagula of blood, plug up the orifices of the vessel and the cavity of the tumour, with lint, and secure the whole by a bandage. The destructive effects of this practice, from hemorrhage, inflammation, and mortification, were soon apparent. Afterwards, encouraged by the effects of ligatures to the artery, and by the difficulties attending mediate compression, surgeons imagined that direct pressure on the arterial trunk, previously exposed by incisions above the tumour, would secure all the advantages of the ligature, and prevent some of its evil tendencies. This was attempted by temporary ligatures, and by various compresses and instruments, usually denominated "compressors of arteries" ("*prêsse-artère*"), but the practice is so evidently opposed to all the modern doctrines of inflammation, relating particularly to the obliteration of arteries, and has been so injurious, that no educated practitioner would warrant its employment. (Vide *Arteries*, *Ligatures*, *Hemorrhage.*)

Direct or immediate compression may, however, be most advantageously made on the affected artery by *ligatures*, more or less firmly applied, by which the immediate or speedy arrest of the circulation in the diseased artery and the tumour, may be effected, followed by coagulation of the blood, and obliteration of the sac and artery. This constitutes the best mode of treatment, and should be resorted to in all practicable cases. In applying ligatures, several modes have been suggested at different eras in medical history, with the relative advantages and disadvantages of which, the surgeon should be familiar; not only that he may decide on that mode

which is in itself preferable, but also on that best suited to existing circumstances.

6. *The ancient mode of applying ligatures* for the cure of aneurisms, consists in laying open the sac, and securing the artery by two ligatures, one above, the other below, the communicating orifice. In the details of the operation, various modifications have been suggested, and as the surgeon may occasionally be forced to resort to it, the following directions are detailed as most conformable to the experience of the best surgeons, and to the doctrines of inflammation, adhesion, &c.

The patient is to be so placed in a horizontal position that the tumour shall be conveniently exposed to the light, and the muscles in its vicinity be relaxed. Suitable preparations being made, a tourniquet should be tightened above the aneurism, by which the pulsations will be arrested and the tumour usually be rendered flaccid. An incision, carried through the integuments in the known direction of the artery, should extend from some distance above the tumour to a point below its inferior margin, avoiding nerves, large vessels, or other important tissues. If arteries or veins of any magnitude be divided, they are to be immediately secured. A second incision should completely expose the interior of the sac, and will of course be followed by a discharge of the laminated coagula of blood, and very generally even by some fresh blood, however securely the tourniquet be applied. By means of the fingers, but especially by soft and moist sponges, the whole sac is to be completely emptied of its contents, so that the surgeon may discover the communicating orifice, which may be recognized by the descriptions formerly given, and will usually be found at the deepest portion of the sac, and rather nearer its superior extremity. If any difficulty occur, the tourniquet should be slightly loosened, when the orifice can be easily detected by the appearance of arterial blood. A large gun-shot probe, a sound, or a catheter, being passed upwards into the artery, the vessel is to be raised and rendered prominent, so that a curved needle, armed with a round, small, but strong ligature, may be readily pushed under the artery as high up as the limits of the wound will permit, care being taken to avoid the accompanying vein and nerve, and at the same time not to transfix the artery. To ascertain whether either of these accidents has occurred, the surgeon may seize the ends of the ligature and draw them; this would give pain, if the nerve were included; the presence of venous blood would indicate the penetration of the vein; and if the artery be properly embraced, no blood would escape on loosening the tourniquet. The probe may now be withdrawn, and the ligature tied with moderate firmness. The lower portion of the vessel ought then to be secured by another ligature in the same manner and with the same precautions. The tourniquet being removed, the whole cavity should be carefully cleansed by soft sponges, and if any collateral branches be found communicating with the sac, they are to be secured effectually by ligatures. After waiting for a few minutes, to observe the effect of the return of the circulation, one extremity of each ligature is to be cut off near the knot, and the other extremity brought out at the superior or inferior angle of the wound, and there fixed by a short strip of adhesive plaster. The cavity should be lightly filled with fine lint, to facilitate the coagulation of any blood which might distil from the small vessels; and the lips of the incision be covered with a pledget of simple ointment, secured by strips of adhesive plaster, and not by a bandage, as ordinarily recommended, which would impede the collateral circulation.

It has been advised, if any difficulty exist in the application of the inferior ligature, from the artery being connected intimately with large veins or nerves, or from any large collateral vessels of importance being involved, that this second ligature be omitted, and the hemorrhage from the lower orifice be prevented simply by filling the sac with lint, and by moderate pressure. So, also, says Bérard, this plugging is requisite when a collateral or recurrent artery enters between the superior and inferior ligature, and cannot be conveniently tied. Such necessities must be rare, and the ligature be almost universally employed, otherwise the danger from hemorrhage would be great.

The patient should be kept at perfect rest in bed, with the limb in the position indicated, and be subjected to a strict antiphlogistic treatment, general and local. The changes which occur in the limb after the application of the ligature to the main artery, will be hereafter detailed. If everything proceed favourably, the general irritation will be moderate; the inflammation of the sac will be soon reduced by suppuration; the matter mixed with blood will be easily discharged from the wound; the ligatures will come away, from the 15th to the 20th day; granulations will form, by which, and by contraction of its parietes, the sac will be obliterated; the external wound

will cicatrize about the 5th or 6th week, and the patient recover, generally with some stiffness or lameness in the affected limb.

It very rarely, however, happens that circumstances are so favourable. On the contrary, the difficulties and dangers of this operation are so great, that many distinguished surgeons of the last century, such as POTT and DESCHAMPS, preferred amputation of the limb to encountering the dangers of opening an aneurismal sac and securing the artery as above directed.

The *difficulties* of the operation are sometimes very great, arising from the necessary extent of the external incision, the wounding of small arteries and veins, the impaction of the coagula of blood in the irregular honey-combed parietes of the sac (sometimes, says DESCHAMPS, they must be rubbed off with a sponge or lint), the continual oozing of fresh blood from the orifice in the artery or some of the collateral vessels opening into the sac, the great depth of the sac, the diseased and adherent condition of the artery, the want of ready access to the orifice in the vessel, and the risk of injuring the nerves and arteries by the passage of the armed needle.

These and other difficulties in the performance of the operation, are often followed by the most serious consequences. Secondary hemorrhage frequently results from the defect of adhesion, and the premature ulceration and sloughing of the artery at the point embraced by the ligature, arising from its morbid condition, by which the patient is often immediately destroyed, or else, he dies from exhaustion in consequence of repeated returns of the discharge.

Inflammation is almost universally inordinate, from the diseased state of the parietes of the sac and vessel, but especially from the exposure of a sanguineous sac to atmospheric influences, by which not only a continuous inflammation is excited, but the blood changes, becomes putrid and irritating, and thus excites extensive suppurative and gangrenous inflammation of the sac and the surrounding tissues, with a degree of general disturbance, which often proves fatal unless amputation be resorted to. Should the patient survive, the recovery is generally tedious, from the formation and separation of sloughs, the existence of chronic fistulæ and caries of bones; and it is often incomplete, as the limb is frequently useless from the anchylosis of joints or the induration or destruction of tendons, muscles, and ligaments. (Vide Cases by PELLETAN, *Clinique Chirurgicale.*) That this operation should, therefore, be performed with reluctance and dread, or that amputation should be preferred by experienced surgeons, cannot be regarded as wonderful. Fortunately, it is very rarely demanded, as other and more successful modifications have been devised.

7. ANEL's *method.* Among the earliest experiments to improve this operation, and thus to avoid its dangers, was the securing of the artery immediately above the tumour, and then to open and cleanse the sac. This mode was adopted by ÆTIUS and PAULUS of Ægina, and in 1590, GUILLEMEAU thus operated on the brachial artery with success. The dangers, however, were not materially lessened, as the patient was liable to hemorrhage from the inferior orifice of the artery and from the collateral vessels opening into the sac, and to the destructive inflammation attending the exposure of sanguineous tumours, although there might be less probability of a secondary bleeding from ulceration at the ligature immediately above the tumour than when applied from within the sac.

A more important modification was suggested and acted on by ANEL, who, on the 30th of January, 1710, secured the brachial artery immediately above an aneurism at the bend of the elbow, and finding that the pulsations of the tumour and the arteries of the fore-arm were arrested, he did not expose the sac. His patient recovered. The advantages of ANEL's method arise from the non-exposure of the aneurismal cavity, and the consequent avoidance of hemorrhage from the collateral vessels, and of the suppuration and gangrenous inflammation of the sac and surrounding tissues; but the dangers were still great from the application of the ligature to a diseased artery and near the tumour. Hence, the liability to secondary hemorrhage was not entirely obviated, and from the proximity of the ligature to the sac, and the morbid state of the vessel, inflammation and ulceration might be excited in the tumour, with the usual unpleasant consequences. Nevertheless, it was a great improvement on the ancient mode; but it does not appear that ANEL or his contemporaries were aware of its peculiar advantages. It was apparently a blind, although successful, experiment; for we have no account of its being imitated by any surgeon prior to the year 1785, during which interval, the ancient mode, by opening the sac, was adopted by all the distinguished surgeons in France, Italy, and England, with occasional success, but often with the terrible consequences above de-

tailed. Ignorant, in all probability, of ANEL's successful experiment, DESSAULT, who has done so much for the honour of France and of surgery, repeated the operation, in June, 1785, and secured the artery above the tumour and near to the sac, in a case of popliteal aneurism. There was no secondary hemorrhage, but *the inflammation extended to the sac*, followed by ulceration and the discharge of pus and blood at the wound. The patient recovered from the immediate effects of the operation, but died in seven or eight months, from caries and ulceration of the tibia, which ensued. (DESCHAMPS. VELPEAU. *Nouveaux Elémens de Méd. Opératoire.* I. 96. Paris, 1833.)

8. HUNTER's *mode*, now termed "*the operation for aneurism.*" From the above review, it appears that there were no fixed principles for the treatment of aneurisms; that what are now termed spontaneous cures, were either unknown or not understood; that the common method of operating was so dangerous that distinguished surgeons preferred amputation; and that the experiment of DESSAULT, being but partially successful, had failed to fix public attention, especially as the principles on which its value depended, were not understood. Under these circumstances, the genius of JOHN HUNTER, the father of scientific surgery in England, was directed to the subject. Mr. HUNTER had studied, experimentally, "those laws which influence the circulating and absorbent systems." He had ascertained, by experiments instituted for the purpose, that the repeated hemorrhages after the application of ligatures in aneurisms, arose from the diseased state of the vessel, and not merely from the mechanical injury inflicted; and was fully informed of the dangers arising from exposure of the aneurismal sac, as well as of the mode by which aneurisms originated and progressed. He hence inferred that if the current of blood were diverted from the aneurismal sac, coagulation would ensue, followed by absorption and obliteration, and that this diversion might be effected by ligatures to the main trunk of the vessel, at such a distance above the tumour as to insure their application to a sound portion of the artery. Two objections, of an opposite character, were urged against this proposition; *first*, that when the ligature was placed far from the tumour, the collateral circulation might return so freely into the vessel below the ligature and above the tumour, as to maintain the momentum of blood in the sac, and thus prevent coagulation; and *secondly*, that by placing the ligature so high up, many of the collateral branches would be useless, and hence, mortification in the limb might ensue from the deficiency of blood. The first objection could only be answered by a trial; the last was contradicted by what was already known of the anastomosing vessels, and of the effect of obliterating the main arterial trunk of an extremity.

In December, 1785, Mr. HUNTER first operated on the above principles, in the case of a popliteal aneurism, leaving the sac untouched, and securing the femoral artery in front of the adductor muscles and near the middle of the thigh, of course about four inches distant from the tumour. The success was complete. The triumph of science was perfect; and to the English surgeon indubitably belongs the credit of devising and executing the operation on scientific principles. "It was not an experiment; it was founded upon close reasoning, supported by experiments made for the purpose, and by long and continued observation of the powers and efforts of nature under similar circumstances." (GUTHRIE, p. 152.) This award is also bestowed by some of the most distinguished French surgeons: BOYER notices the peculiarities and superiority of the Hunterian method over ANEL's or DESSAULT's; so, also, MARJOLIN and BÉRARD, in their well digested article on Aneurism, in the Dictionnaire de Médecine, now publishing.

The *advantages* of the modern operation are apparent and important. The incision is not extensive, and is made in sound parts, where there is no displacement of tissues, or preternatural adhesions. The ligature is applied to a healthy artery, under the most favourable circumstances, so as to produce the least possible irritation, and to facilitate the adhesion and obliteration of the tube; and the wound in the integuments being remote from the swelling, the succeeding inflammation will not be propagated to the sac, which will be obliterated as in cases of spontaneous cures. The general irritation is usually trifling, and not greater than unavoidably results from the constriction of a large artery.

The Hunterian operation is therefore to be adopted in all practicable cases; and even when, from the approximation of the aneurism to the trunk, the ligature cannot be applied to a sound portion of the artery, we must be governed by the principles established by the English surgeon. Many circumstances demand attention, that even the simplest mode of operating may prove

successful; for, as Mr. Burns observes, "the mere tying of an artery is a serious operation," when the vessel is of any magnitude.

The operation ought to be *early* performed, prior to the excitement of active inflammation in the sac and surrounding parts, the formation of preternatural adhesions, or the occurrence of severe pain, or of sanguineous and œdematous congestions in the inferior portions of the limb, from pressure on the nerves, veins, absorbents, skin, or fasciæ. The idea that its performance should be delayed for the development of the collateral vessels, is incorrect, and even dangerous, as there is little danger, whatever vessel may be secured, of mortification from the want of blood, while there is great danger from the increasing irritation, size, and pressure, of the aneurism.

The general health of the patient ought to be good, as there is no more frequent cause of secondary hemorrhage, or of inordinate inflammation in the artery or sac, than an irritable state of the system. This should therefore be corrected as much as possible, prior to an operation; particular attention being paid to any derangement in the functions of the brain, lungs, heart, or abdominal viscera, and all symptoms of plethora or fever should be obviated.

It is true, however, that a ligature to the artery some distance above the tumour, is comparatively so simple and safe, that none of the above complications absolutely forbid its employment when the case is urgent, as patients have often recovered under circumstances the most unfavourable. Sir A. Cooper has successfully operated in two cases, even after gangrene of the sac had commenced (*Medico-Chirurg. Trans.* IV. 431.); and in many instances, patients have recovered after ulceration of the bones has been excited, or when the artery has been ossified.

In performing the operation, great care is demanded, and also a minute attention to points apparently of little importance, (such as the form, size, and materials, of the ligatures,) which have been the subjects of skilful investigation, and even of excited disputation. For the facts and arguments, we must refer to the appropriate heads (*Hemorrhage*, *Ligatures*, &c.), contenting ourselves with the simple expression of what we believe to be the most approved mode of operating, both as regards the facilities of execution and also the welfare of the patient.

Mode of Operating. Prior to the commencement of the operation, the surgeon should determine, in each individual case, the precise portion of the artery to be secured; in doing which he must be governed by certain general principles, modified by the circumstances of the case.

1. The ligature is to be applied, if possible, to a sound portion of the artery.

2. No very large collateral artery ought to intervene between the ligature and the tumour.

3. The ligature should not be fixed near a large collateral branch; for example, near the *arteria profunda* of the thigh, as adhesion is less likely to ensue.

4. Neither should it be fixed near the tumour, as the inflammation might be propagated to the sac.

5. Sometimes, although very rarely, the anastomosis is so free between the portions of the aneurismal artery above and below the tumour, especially in the fore-arm and leg, that a second ligature below the tumour is requisite, after it is evident the first, from this cause, is inadequate.

Suitable preparations being made, and a proper position chosen, as above indicated, an incision with a convex-edged scalpel should be made through the integuments only, and directly over the course of the artery. This first incision, and also the subsequent ones, especially that by which the fasciæ are divided, ought to be long, so as to allow sufficient room for further manipulations. The dissection is to be carefully prosecuted with the edge of the scalpel, until the sheath of the vessel is exposed, the surgeon being guided by the pulsations of the artery, and his assistant frequently sponging the wound, that the different tissues may be easily detected. If muscles intervene, the dissection should usually be continued around them, that they may be drawn to one side by an assistant. In some few instances, muscles may be divided transversely, as when they are very broad and cannot easily be raised, when they are rigid, spasmodically contracted, or indurated, when the artery is found diseased at the place of election, and must be secured higher up, as occurred to Dupuytren in regard to the subclavian artery, and also to our countryman, Dr. Mott.

The sheath of the vessels being thus exposed, is to be opened very carefully, generally by pinching up a portion with the forceps or fingers, and dividing it with the edge of the knife turned from the vessel. By the scalpel alone, its back being presented towards the artery, or assisted by a grooved director, the orifice is to be enlarged in each direction. The ligature

is now to be passed under the artery, with as slight disturbance and division of the tissues as possible. This is best accomplished by what is termed an aneurismal needle, or a short and flat, eyed probe, of silver, sufficiently curved, and armed with a strong but small and round silk ligature. The point is to be carried between the vessels, so as to pass under the artery and ascend on the side opposed to the vein, great care being taken to avoid injuring, and especially including, the accompanying nerve. The ligature is thus passed without separating the artery from its attachments, or in any degree injuring its *vasa vasorum*, and it embraces the artery alone. That the artery is really included, should be ascertained by drawing the two extremities of the ligature and placing the index finger on the artery, in which case the pulsations should cease. The ligature being properly arranged, should be tied perpendicularly to the artery, in a simple knot, with that degree of firmness requisite for the rupture of the internal and middle coats of the vessel, without causing any solution of continuity in the external coat. That the succeeding inflammation may be moderate, one extremity of the ligature should be cut off near the artery. The wound must now be cautiously cleansed without the use of frictions, by means of a sponge, and, the end of the ligature being secured at one angle of the incision by adhesive plaster, the lips of the wound should be approximated and thus retained by adhesive strips placed obliquely, so as not to encircle the limb. A small pledget of cerate may be laid on the wound, and the whole covered with some soft lint to receive the oozings of blood and to facilitate coagulation. This lint may also be lightly secured by an adhesive strip, rather than by bandages, as usually recommended, and which would interfere with the collateral circulation.

Considerable difficulty has often been experienced in passing the ligature under the artery, especially when deep-seated and in narrow wounds. For the many ingenious suggestions for accomplishing this object, reference must be made to the article on *Ligatures*, where they are fully detailed.

The direction to carry the point of the needle first between the artery and vein, rather than to allow it to ascend between these vessels, is of importance, as, in the latter case, the vein would frequently be injured, so that venous hemorrhage might immediately ensue, or phlebitis be excited, with all its unpleasant consequences. Injury of the nerve, also, might excite severe pain, spasms, convulsions, neuritis, &c., and if it or the vein were embraced by the ligature, mortification of the limb might ensue.

The rupture of the internal coats by the ligature, is a desirable circumstance, as direct adhesion, the obliteration of the vessel, and the discharge of the ligature by ulceration or sloughing, thus occur more readily than if the opposing surfaces of the internal tissue were merely brought into contact, as advised and practised by Scarpa and his followers. For details of the facts and arguments on this interesting practical point, which by some is still regarded as undecided, we must refer to the subject of *Ligatures*, simply remarking that the whole question is virtually reduced to this; Whether adhesion will ensue most readily when two opposing surfaces are brought into strict contact with, or without, a solution of continuity? We believe that experience is in favour of producing a rupture or wound; and, as regards arteries, that in all cases the danger of secondary hemorrhage is not enhanced by the isolation and constriction of their cellular coat, and that adhesion is further facilitated by the curling inwards of the internal and middle coats, so as to bring a larger ruptured surface into immediate contact, as remarked by Guthrie. If these views be correct, the preference must be given to the small and round ligature, over the flat or ribbon-shaped ligature of Scarpa, for obvious reasons; and it should be firmly applied, for experienced surgeons declare that even with a ligature of fine dentists' silk, it is difficult to divide the external coat. The artery should be tied perpendicularly or transversely, that the ligature may not slip or become prematurely loosened; and the directions not to detach the vessel from its connexions, not to irritate or contuse its walls unnecessarily, not to allow both extremities of the ligature to remain in the wound, and not to keep the lips of the incision separated, but, on the contrary, carefully to approximate them, are all founded on the importance of direct adhesion and of avoiding suppuration and ulceration, excepting the trifling degree requisite for the detachment of the ligature. On the same principle, perfect rest and an antiphlogistic treatment are usually requisite; inordinate inflammation, with its mischievous consequences, being apt to ensue in the artery, causing arteritis, secondary hemorrhage, &c., or in the surrounding parts, exciting severe general irritation, often of a dan-

gerous tendency. On these same principles, sustained by ample experience, the practice of detaching the artery extensively from its connexions, of passing two ligatures and dividing the vessel between them, of employing temporary ligatures, or "ligatures of reserve," is always to be condemned. We believe that the same condemnation, and for similar reasons, should be extended to the proposition of Dr. JAMESON, of Baltimore, to transfix the artery by setons, or of VELPEAU, of Paris, to perforate it by needles. Although by either method, obliteration may ensue, yet this is, by no means, a certain event; for, in some cases, the inflammation is too trifling to promote a sufficient effusion of lymph, the sides of the vessel not being in contact, and, in all cases, there is a liability to ulceration at the punctures, and to that dangerous continuous inflammation of the lining membrane, which occurs most readily where immediate adhesion is delayed.

Respecting the *materials* for the ligature, experience at present is in favour of an indestructible substance, particularly of silk properly prepared, as having great strength in proportion to its magnitude; but the question is yet open as regards the suitability of animal ligatures for aneurismal arteries. These are recommended by the fact that they are speedily softened and dissolved by the fluids, so that in a short time the knot even disappears, or may be removed, and a more speedy cicatrization of the wound be effected. Further experiments are however required to determine whether, in all cases, adhesion of the internal ruptured surfaces of the artery will occur before the ligature be loosened; of which there is some doubt, as an animal ligature becomes soft and relaxed in a few hours. Its advocates deny that there is any danger of failure, and affirm that few, if any, instances of secondary hemorrhage have followed its employment.

The dressings of the wound should facilitate immediate adhesion; hence the necessity of cleansing the part carefully, even of coagula of blood; of accurately approximating and retaining in contact the edges of the wound; of promoting the coagulation of the blood, so as to form a scab over the part; of avoiding thick dressings, of lint, plasters, compresses, and bandages, by which heat would be accumulated and the inflammation aggravated beyond the degree requisite for adhesion.

EFFECTS OF THE LIGATURE—a. *On the Circulation.* As soon as the ligature is tied, the pulsations of all the arteries, and of course, of the aneurism, immediately cease; the tumour becomes softer, sometimes flaccid; the limb pallid and cold, in most instances, and often the patient complains of a distressing sensation of numbness. Very generally, in a few hours, the capillary vessels are filled with blood, so that the temperature of the limb increases and often exceeds that of the sound limb; the aneurismal sac becomes distended, and not unfrequently manifests some pulsation from the free ingress of blood from the anastomosing vessels, which open either into the artery above the aneurism, into the sac itself, or into the artery below the tumour, the blood of course pursuing a retrograde course from smaller into larger vessels. The momentum, in all cases, is greatly diminished, and although pulsation may be excited in the swelling, yet very universally it is faint, gradually becomes weaker, and speedily disappears, owing to the coagulation of blood in the sac and artery, as in spontaneous cures of aneurism. The circulation is re-established, in the manner formerly explained, in all the arteries of the limb, excepting in the diseased vessel at the original seat of the disease, and also at the spot where the ligature is applied.

Occasionally, from various causes, these favourable changes do not occur, and the circulation is not restored; hence, mortification ensues from deficient supply of blood, being sometimes confined to the fingers or toes, or to portions of the surface, but not unfrequently extending into the very substance of the limb; of course endangering the life of the patient. Mortification sometimes ensues after the circulation has been restored, apparently from an excessive engorgement of the vessels, as they become turgid, and the limb is swelled and livid.

The *causes* preventing the perfect re-establishment of the collateral circulation are numerous, and may often be prevented, but sometimes are unavoidable. The most frequent are old age; great debility or exhaustion; great distension of the sac; pressure from bandages, ligatures, or the mere weight of the limb; large transverse wounds interesting the collateral and anastomosing vessels; wounds or ligatures on the large veins or nerves of the limb; and especially the use of cold or astringent lotions to the parts affected. The opposite extreme of applying too freely, caloric or stimulating liniments, is almost equally injurious, as reaction is rapidly and inordinately induced, followed by engorgement and mortification. (HODGSON, p. 259.)

The general circulation is sometimes disturbed from the application of the ligature, inducing symptoms of plethora, in the viscera more especially, and hastening the progress of any other aneurism, external or internal, which may exist.

b. *On the Tumour, and Artery.* As already intimated, the effects of the ligature on the tumour and artery are precisely similar to what occurs in spontaneous cures, when circumstances are favourable. The changes at the wound, from the ligature, are also the same as in ordinary cases of incised wounds with ligature on an artery, the ligature coming away, in 15 or 20 days, by the ulcerative process, involving the external coat merely of the artery, while the vessel becomes obliterated to the first branch upwards and downwards. If, therefore, the ligature be near the tumour, the artery is obliterated from the first ramification above the ligature to the first below the aneurism. If, however, as is usually the case in operations on the front of the thigh for popliteal aneurism, collateral vessels open into the artery between the ligature and sac, this portion remains pervious, while the artery is obliterated at the sac and at the ligature.

Difficulties, however, occasionally arise. The aneurism may continue to increase from the continued afflux of blood, owing to the ligature not being firmly applied, or to the free anastomotic circulation. In some cases, inflammation, suppuration, and gangrene ensue in the sac, resulting in ulceration and sloughing, which, if it occur rapidly, may be followed by dangerous and even fatal hemorrhage from the sac; but usually no bleeding succeeds, the artery being closed with coagula. This is true especially when the inflammation does not occur immediately; it may be delayed for weeks and months. Dupuytren observed it a year after the operation. In either case, however, the patient is endangered from the degree of irritation and the absorption of putrid fluids, but he not unfrequently survives. This inflammation may arise from the great size of the tumour, from its prior diseased state, from the ligature being applied near the sac, and from various causes which may be termed accidental, such as contusions, falls, &c.

Inordinate inflammation may also ensue in the wound and artery, from similar causes, but more especially from an irritable or other morbid state of the general system, from diseased condition of the artery, from the use of numerous ligatures, from the improper size or application of even the single ligature, from unscientific dressings, especially when they are so numerous as to accumulate heat in the part, from premature efforts to remove the ligature, from the occurrence of erysipelas or other inflammatory affections in the surrounding tissues, or from exposure to changes of temperature.

Under such circumstances, the inflammation may transcend the adhesive stage; suppuration, ulceration, and even gangrene occurring, followed too frequently by a destruction of a portion of the artery, prior to its being plugged up completely by coagula, or adherent by the effusion of lymph. Hence, hemorrhage ensues, termed from these circumstances, "*secondary hemorrhage;*" occurring, of course, more readily when the momentum of blood in the artery is aggravated by any cause, especially by fever or motion, or by assuming a standing or sitting posture, by which the column of blood is increased and the circulation impeded. This is one of the most dangerous accidents which can occur, and fortunately, is much less common since proper principles have regulated the mode of operating and the subsequent treatment.

The bleeding most frequently issues from the superior (Guthrie says, from the *inferior*) portion of the artery, and is often attended with much uneasiness and pulsation: it is sometimes moderate, but often alarming, especially as bearing the arterial character. From the lower portion, it is less vehement, and perhaps less dangerous. The blood, also, is of a darker colour. Secondary hemorrhage, arising from inflammation, is rarely observed before the 6th day, and seldom appears after the 25th or 30th day.

This inordinate inflammation is not always confined to the wound, but may extend to the cellular tissue, to the muscles, or even to the lining membrane of the artery (arteritis). In such cases, the local and sympathetic irritations are exceedingly great and dangerous. In some irritable patients, these evil consequences may result immediately from the constriction of the artery. Sometimes the nervous system is more especially disturbed, whence, spasms, delirium, convulsions, often accompanied with great prostration of the organic actions.

Treatment after the operation. This must be founded on the facts and principles now detailed. Perfect rest, in a horizontal position, must be preserved until the ligature has been discharged and all danger of secondary hemorrhage has been dissipated. The diet should be exceedingly

mild, but sufficient to relieve the sensations of hunger, and the bowels be kept regular by enemata; while nervous symptoms are to be quieted by anodynes, and evidences of vascular fullness or excitement to be counteracted by suitable evacuations, occasionally, from the veins. The limb is to be supported on soft materials, as carded cotton, wool, &c., so as to prevent pressure on particular points, which might mortify, and be covered with similar non-conducting materials, to preserve it from the influence of even a cool atmosphere, and allow of the accumulation of animal heat. Sometimes, artificial heat is demanded, by means of bags of hot sand, oats, ashes, bottles of warm water, &c., placed near, but not in contact with, the surface, as they would injure, from pressure or over-stimulation. The temperature of the limb ought to be frequently examined, and suitably regulated, especially when the circulation returns, as the excitement of the capillaries is prone to be excessive, and may be followed by sphacelus from congestion. If the excitement be inordinate, the limb may be slightly exposed to the air, and may sometimes be washed with a spirituous lotion, or blood may be detracted by a few leeches at the upper portion of the extremity; but all active interference by cold and astringents is very dangerous, and has been followed by complete sphacelation.

When the circulation does not readily return, the warm applications are to be perseveringly employed, and frictions, with or without stimulating liniments, adopted; but especially should the cause be investigated, and, if possible, be obviated. This may easily be effected when the difficulty arises from an improper position of the limb, or from bandages, interfering with the collateral circulation. The danger of mortification is great, when the re-establishment of the circulation is impeded by the magnitude of the aneurism. Dr. Physick has proposed, in such cases, to puncture the sac with a small needle, that some of the fluid contents might be evacuated; but as these would be speedily replaced, little permanent advantage could be expected. If mortification be threatened from this cause, the tumour should be laid open, and if coagulation in the vessel has not ensued, the *ancient operation* must be performed, or amputation resorted to. To avoid either of these unfortunate resorts, it might in some cases afford sufficient relief to make a free incision through the skin and fasciæ which bind the aneurism. Tension would thus be relieved, the collateral circulation be re-established, and although inflammation and suppuration might (but this is not a necessary consequence) ensue, yet it would be delayed until coagulation had occurred in the artery, and the danger of hemorrhage be removed.

In all these cases of sphacelus from defect of blood, we must be governed by the common principles for the management of *traumatic gangrene*, promoting the sloughing process when the eschar is superficial, and amputating immediately, before the progress of mortification is arrested, in those cases where the whole thickness of the limb is involved.

When the circulation is again established, the natural process of cure by coagulation and obliteration should be facilitated by the medical measures already recommended, especially when the pulsations of the tumour continue. If the aneurismal symptoms remain, moderate compression, if tolerated, might be advantageous. Often, however, there is some unusual source for the influx of blood into the sac, which should be investigated by examining the effect of pressure on the artery above and below the tumour. If pulsation be arrested by pressure above the aneurism, the surgeon, says Mr. Hodgson, would be justifiable in applying another ligature nearer to the sac; and when the influx is evidently from the inferior portion of the artery, a ligature below the tumour may intercept the recurrent blood, particularly in aneurisms situated in the fore-arm or the leg. When, however, no particular vessel can be designated, or when these secondary ligatures have been unavailing, the "ancient operation" would seem preferable to amputation, which has been recommended. These cases fortunately are exceedingly rare, and perhaps never occur except in preternatural distribution of the arteries, or when the aneurism is situated near the hand or foot.

Severe inflammation of the sac is to be managed on common principles, and when suppuration or gangrene occurs, incisions are demanded for the evacuation of the pus, blood, and sloughs. Hemorrhage, in such cases, seldom ensues, as either coagulation of the blood or adhesion of the artery has taken place. Should it appear, amputation is almost the sole resource of the surgeon.

The *management of secondary hemorrhage from the wound* demands great skill and boldness. If moderate, it may be arrested by cold and astringents, by plugging the cavity, and by moderate compression, assisted by rest, position, and medical

means. If, however, as is usually the case, it be profuse, the artery must be secured by another ligature, not at the wound, where the vessel is inflamed and friable, and where rapid ulceration would almost certainly ensue, but above the original incision, and "beyond the circle of the inflammation." Sometimes, from the diseased state of the vessel and the irritable condition of the system, successive ligatures become requisite, to be assisted by medical means, by compression, &c. Sometimes, amputation must at last be performed: this, however, is very rarely demanded.

The treatment of inflammations of the arteries, veins, nerves, or cellular tissue, and of the general sympathetic disturbances, whether nervous or vascular, which may complicate the case, requires no peculiar notice; the surgeon being, however, always prepared for secondary hemorrhage, by which the most flattering anticipations are often suddenly prostrated.

Fortunately, in most cases of external aneurisms, few of these complications exist; but the force of the circulation being moderated or destroyed by the Hunterian operation, the natural process of cure is effected without any severe irritation. The wound is to be frequently examined; inordinate inflammation restrained by leeches and cool applications; and if suppuration occur, the dressings are to be very carefully renewed, so as not, in the most trifling degree, to disturb the ligature or separate the edges of the wound. The entire wound should unite by the "first intention," excepting in the tract of the ligature, where suppuration must necessarily ensue until the ligature is loosened and discharged, which usually occurs from the 15th to the 20th day. The wound will now completely cicatrize, and the patient may make slight muscular efforts, to be gradually but cautiously increased. The process of obliteration in the tumour is tedious, often requiring months and years, but no inconvenience is experienced; the patient returns to his usual avocations, often without any impediment to the healthy functions of his limb. Sometimes, a permanent stiffness or lameness may exist from the injury of ligaments, bones, and joints, prior to the operation.

The Hunterian operation is therefore beneficial precisely on the same principles as the medical measures instituted by Valsalva; each practice being founded on the importance of diminishing the momentum of the blood in the aneurismal sac, that recoveries may ensue by the coagulation of blood in the tumour and artery, and eventually by the condensation and absorption of their parietes and contents. The former, however, being far more effective and safe, should be preferred in all cases of external aneurisms to which it can be applied.

9. Brasdor's *mode*. There are, however, certain cases of aneurism in which the modern operation is impracticable, or at least exceedingly dangerous, as when the swellings appear at the lower part of the neck, arising from the arteria innominata, the carotid or subclavian arteries, or at the groin or iliac fossa, when the external iliac artery is affected. Much permanent utility not having ordinarily resulted from medical measures, such cases are generally fatal. About the year 1780, M. Brasdor, Professor de l'Ecole de Médecine, proposed the application of a ligature beyond the aneurism, "*ultrâ tumorem*," between the tumour and capillaries. Dessault also mentioned it in his lectures, but neither of these distinguished men had an opportunity of operating. The first attempt was by their contemporary, Deschamps, who undertook, on the 14th of October, 1797, to secure the femoral artery, for a large aneurism at the groin. No good resulted; and the experiment being considered as a complete failure, no further attempts were regarded as justifiable by the continental surgeons. Sir A. Cooper, however, in 1808, repeated the operation, for aneurism of the external iliac artery, with much temporary advantage and with flattering prospects of success, for the ligature came away favourably, the wound healed, the tumour greatly diminished in size, and its pulsations were very indistinct. The patient was considered convalescent, and sent to the country for the re-establishment of his health. The tumour now increased, followed by rupture and death. No examination post mortem was allowed. Surgeons were again discouraged; believing that the operation was contrary to all scientific principles, as well as opposed to experience. Mr. Wardrop, however, entertained different theoretical sentiments, and was bold enough, in June, 1825, to secure the common carotid artery a little before its bifurcation, for an aneurism at its root. This was easily effected, and with complete success. Professional attention was now arrested, and the operation, during the succeeding five years, has been repeated on some fourteen patients, under various circumstances and with different results, as will be observed from the following table:

TABLE

Of Cases in which Brasdor's Operation has been performed; with a Summary of the Symptoms.

SERIES I. Where no collateral vessels were given off at the sac, or between it and the ligature.
SERIES II. Where such vessels passed off above the ligature and below, or at the aneurism.

SERIES FIRST.

Date.	*Operator.*	*Sex and Age.*	*An. Artery.*	*Artery tied.*	*Result.*	
1825. June.	Wardrop.	Female, æt. 75.	Root of Carotid.	Right Carotid.	Recovery.	Immediate diminution of the tumour; continued decrease until 5th day, when inflammation, suppuration, ulceration, discharge of blood and matter. No hemorrhage. In the year 1830, remained well.
1827. March 1.	Lambert.	Female, æt. 49.	Root of Carotid.	Right Carotid.	Amendment. Relapse, and death, May 1.	Diminution of bulk. 10th day, slight hemorrhage from wound. This ceased, the wound healed, and tumour disappeared. In 5th week, ulceration of wound. 18th April, hemorrhage, which returned at intervals. Death, May 1. *Dissection:* Pericarditis, dilatation of the aorta, arteria innominata healthy. At root of carotid, remains of tumour filled by coagulum, which completely obstructed the sac and also the artery. The artery was thickened. Above the tumour, where the ligature was applied, it was opened by ulceration.
1827. Sept. 11.	Bush.	Female, æt. 36.	Root of Carotid.	Right Carotid.	Recovery.	The aneurism was very large and advanced; suffocation imminent. Operation difficult from size of tumour. Sudden diminution of size of tumour when artery tied. Had pain and excitement. *V. S.* 4 times. Tumour decreased, and pulsations weaker. Ligature came away on 19th day; wound cicatrized on the 27th day. Recovery perfect. Patient "alive and well, March, 1830."
1826. Dec. 10	Wardrop. 2d operation.	Female. E. B., æt. 57.	Root of Carotid.	Right Carotid.	No improvement. Death, March 23.	No diminution in tumour. Pulsations rather weaker. Sac could always be completely emptied by pressure. End of 3d week, from cold and intemperance had cough, fever, &c. Tumour and pulsations continued. *Died* March 23d, with symptoms of hypertrophy of heart. *Dissection:* heart greatly enlarged; tumour collapsed, being formed of dilated coats of artery. *Carotid artery was completely pervious.*
1829. March 9	Montgomery, Isle of France.	Male, æt. 40.	Supposed Left Carotid.	Left Carotid.	*Apparent* recovery. Relapse and death.	March 12. Tumour much decreased, and no pulsation to be felt. Mar. 18. A slight pulsation in one spot of tumour. Mar. 20. A little hemorrhage from wound. Mar. 21, 22. Hemorrhage returned. Mar. 26. No hemorrhage and no pulsation. Mar. 28. Aneurismal tumour enlarged. Apr. 3. Small abscess at cicatrix. May 29. The tumour, which had been enlarging, ulcerated, and discharged 8 oz. of fetid chocolate-coloured fluid: no hemorrhage. June 8. Patient walked out: no discharge from wound, which is nearly healed: no tumour existing. Soon after, health became impaired; and on July 3, suddenly expectorated 6 oz. of fluid blood; afterwards, pus and blood; exhaustion; death July 11. *Dissection:* Left carotid obliterated to its origin. No vestige of aneurismal sac interesting the carotid. There was, however, an aneurism of aorta, size of an orange, between left carotid and arteria innominata. The rupture was closed by lymph. Pericarditis, water in cavities, &c.

SERIES SECOND.

Date.	*Operator.*	*Sex and Age.*	*An. Artery.*	*Artery tied.*	*Result.*	
1797. Oct.	Deschamps.	Male.	External Iliac.	Femoral Artery.	Death.	No good effect from ligature. Tumour increased rapidly. Death occurred. *Dissection:* Artery and vein were found secured. Reason to suppose artery was obliterated prior to the operation, as no pulsation below tumour could be perceived.
1808.	A. Cooper.		External Iliac.	Femoral Artery.	*Death,* after apparent amendment.	No increase of tumour. Pulsation continued. Ligatures separated favourably. Aneurism greatly diminished, so that patient went to the country to recruit his health; where rupture of aneurism and death occurred. No examination *post mortem.*
1827.	White.		External Iliac.	Femoral Artery.	Death.	Artery was found obliterated below the tumour. No change from ligature. Death from erysipelas.
1829. June.	James.		External Iliac.	Femoral Artery.	Death.	Ligature below the profunda artery. No change in tumour. Continued to increase. Aorta was tied.
1829. Sept. 26.	Mott.	Mr. Gardiner, æt. 51.	Arteria Innominata.	Right Carotid.	Apparent recovery. *Death* from suffocation, April 22, 1830.	Circulation before operation interrupted in right arm (no pulse at the wrist); slightly in right carotid. No change on tying ligature. 27th. Pulsation and size of tumour diminished. 28th. better; pulse now at wrist. Oct. 10. Pulsation of tumour hardly perceptible. 16th. Ligature came away; pulsation and tumour disappeared. 22d. Wound healed; arm œdematous; pulse in radial artery not perceptible. 26th. Patient returned home. *Dissection:* No tumour externally; internally, was as large as two fists, extending from under sternal extremity of left clavicle to middle of right clavicle, and greatly displacing the trachea, which was attached to its left side and very much flattened. Parietes of the tumour firmly consolidated. Aneurism arose from arteria innominata, involving subclavian and root of carotid. Right carotid was obliterated. The right subclavian beyond the tumour was pervious and natural in its structure. Heart and lungs sound.

TABLE—*Continued.*

Date.	*Operator.*	*Sex and Age.*	*An. Artery.*	*Artery tied.*	*Result.*	
1830. July.	Key.		Arteria Innominata.	Right Carotid.	Death.	This event occurred in a few hours after the operation.
1828. July 22.	Evans.	W. Hall, æt. 30.	Arteria Innominata; and Root of Carotid.	Right Carotid.	Recovery incomplete.	Pulsation stronger on the 23d. *V. S.* required for excitement on the 25th and 26th. On the 29th, appeared to be dying. Ptyalism occurred with relief; arteries of right arm and fore-arm became obliterated, process commencing on the 8th day. Right arm was partially paralyzed, as also right side of face. The whole right side of body was similarly affected. Aug. 15. Pulsations in tumour diminished, and on 23d of August so much lessened as to be merely "elevating," not "excentric." In 5 weeks, rode daily on horseback. Oct. 22. Tumour reduced to one third of former size; is hard and firm; pulsation hardly perceptible. Attends to his business as a drover. June 15, 1829. Tumour stationary; health good; was intemperate; had falls; took cold: tumour increased. Aug. 27. Tumour now of three lobes; the original one large, but hard and indurated; the others, soft and fluctuating. No pulsation in any part. Auscultation indicates pulsation deep-seated. Tumour not affected by pressure; right upper extremity is nearly restored to its perfect use. Health is excellent.
1827. July.	Wardrop.	Mrs. Denmark, æt. 45.	Arteria Innominata.	Right Subclavian.	Apparent recovery. Relapse. Death.	No pulse in right carotid before the operation; subclavian was tied. Tumour not immediately diminished, but pulsation weaker. On 9th day, pulse in carotid returned. 22d day, ligature separated, and tumour much diminished; patient walks out. In August, went to the country; the tumour, which was nearly half the size of a turkey's egg, is nearly gone. Dec. 5. No vestige of tumour. Soon after, patient very ill from bronchitis, &c. (See account, p. 531.) Death occurred on 13th Sept. 1829. *Dissection:* Aneurism seated in arteria innominata, is firm, coats much thickened. Laminated coagula remarkably firm and pallid; darker and softer towards the boundaries of the cavity, which last was about the size of a walnut. Subclavian divided at the ligature. Carotid healthy and pervious.
1829. Jan. 12.	Dupuytren.		Subclavian Artery.	Axillary.	Death.	Tumour diminished; but on the 8th day, secondary hemorrhage at ligature, and death. *Dissection* showed that the thyroid, mammary, and vertebral arteries, which originated from the sac, were all *impervious.*

The operation has therefore been performed in fourteen cases; five of which belong to the first series, and nine to the second. Of the five cases, Mr. Wardrop's 2d case, E. B. ought to be rejected, as dissection showed that the disease was a dilated artery, not an aneurism; and secondly, that the artery was not obliterated by the ligature, if indeed it had ever been secured. The 5th case ought to be considered as doubtful. Mr. Guthrie believes, and apparently with justice, that there was no aneurism of the carotid, but that the aortic aneurism formed the swelling on the neck, as no vestige of a carotid aneurism could be discovered after death. The case, however, is most valuable, in either point of view; in the one case, showing that a carotid aneurism can be perfectly cured by the ligature *ultrâ tumorem;* or on the other supposition, showing the advantageous influence (in some way) of a ligature on the carotid in an aneurism of the aorta. *Of the first series*, therefore, the operation of Brasdor has hitherto been performed only in *three decided cases;* two patients have perfectly recovered, from situations completely desperate, (and one of them 75 years of age), and remained well for years; and in the third case, Mr. Lambert's, the process of recovery was advancing regularly, as proved by the symptoms, and afterwards by dissection, when it was arrested by hemorrhage *beyond* the tumour, at the ligature. These cases are therefore very encouraging.

Experience indicates, however, what was indeed anticipated by Hodgson and others, that this operation must be less effectual where collateral vessels, passing off between the sac and ligature, maintain a circulation through the aneurism. Nevertheless, much has been accomplished, considering the hopeless condition of the patients, and especially the complications which existed. Of the nine cases reported under the second series, some should be rejected, as furnishing no argument or facts, for or against this mode of operating. Mr. Key's patient died in a few hours. In Mr. White's, the artery was obliterated before the ligature was applied; of course, the operation was injurious, rather than useful, by aggravating the ulcerative inflammation of the sac. In Deschamp's case, also, *no pulsation existed in the artery*, and the irritation and danger were exceedingly aggravated by an extensive and tedious dissection, and by securing the vein as well as the artery in the ligature. *Of the second series*, therefore, *six cases* presented the requisite circumstances jus-

tifying an operation. Two patients died soon after the operation; M. Dupuytren's on the eighth day, from secondary hemorrhage at the ligature; and Mr. James' after the aorta had been secured. Of the remaining four patients, all were decidedly benefited, life being prolonged and their sufferings ameliorated. One, Hall, was living and actively employed, at the last accounts received, although the tumour had reappeared, from his various acts of imprudence. Mr. Cooper's patient was apparently convalescent, but death ensued, from rupture, caused perhaps by neglect and premature exercise, the patient having gone to the country. Dr. Mott discharged his patient as completely cured, showing the influence of the operation. Death occurred unexpectedly from pressure causing flattening and displacement of the trachea. Mrs. Denmark was greatly relieved, and at one time apparently cured, but died eventually from other complaints.

From this statement, it is evident that the degree of success is sufficiently great to authorize a surgeon to apply a ligature beyond the tumour, under certain circumstances; as when medical means fail, when the Hunterian operation is impracticable, and when the life of the patient is in imminent danger. That he may operate with the best chance of succeeding, the theory of the operation should be well understood, and its advantages and dangers be fully pourtrayed.

Theory of Brasdor's *operation.* This proposal is founded on two fundamental principles: *first*, that the diminution merely of the momentum of the blood in an aneurism, when effected to a certain extent, will be followed by the coagulation of the blood, and by obliteration of the sac and artery: and *second*, that a diminution of the momentum may be accomplished by a ligature beyond the tumour, and sometimes to the required extent.

The truth of the first principle we have considered already, and it seems to be universally admitted, as even after Hunter's operation, the blood has, in most instances, access to the sac, although with a lessened impetus.

Respecting the second principle, the highest authorities have expressed doubts, and even positive dissent, contending, that when a ligature is applied on an artery, the impetus of blood against its parietes must be greater than when the tube remains pervious; and of course, if an aneurism exist, that the momentum against its walls would be aggravated and its progress accelerated. Hence, Mr. Allan Burns condemns the operation, as "absurd in theory," and asserts that experience (as far as it had then gone) "proves it to be ruinous in practice."

The correctness of these assertions was doubted, for it was already known, that if a fluid were flowing from a common trunk through numerous ramifications with a certain degree of momentum, and one of these ramifications be suddenly obstructed, the impetus of the fluid is immediately increased in all the pervious tubes; showing that any augmentation of pressure is not entirely sustained by the obstructed tube, but is at least divided among the several branches. In the human body, facts seemed to prove, that this pressure on an obstructed tube was actually lessened, instead of being increased. Microscopic observers inform us, that whenever obstruction occurs in a blood-vessel, the blood leaves that vessel, moving in direct opposition to the *vis a tergo* from the heart and arteries, while the now impervious tube, instead of enlarging, actually diminishes in size. This observation is confirmed by the almost universal experience of surgeons in the use of ligatures to arteries. The *cul de sac* of the artery contracts and becomes obliterated, in a vast majority of cases, near to the first collateral branch. It never becomes aneurismal, unless the tube be diseased, and then very rarely. A case is related by Warner, in which he found the humeral artery to dilate above a ligature, after amputation; rendering another ligature to the vessel above the aneurismal part requisite. The artery again dilated; a third ligature was applied; and dilatation occurring the third time, a fourth ligature was requisite, and was not followed by any relapse. A similar dilatation occurred after amputation of the leg by M. Roche, in 1813, so that the posterior tibial artery had to be secured near its origin. Hodgson mentions cases, in which arteries, after being secured, remained open for some distance below the collateral branches, and above the ligature, but no dilatation ensued. These cases are, however, exceptions to the general rule, that contraction of the stump of an artery follows its obstruction. Hence, it might reasonably be concluded, that the impetus of blood against the parietes of an aneurismal sac would not be materially augmented by a ligature on the artery *ultrâ tumorem*, and even that it might be lessened.

Experience has fortunately confirmed these views; for in most cases in which the operation has been performed, there was at least a temporary diminution of

size, and in several cases this has occurred immediately on tying the vessel; especially in the carotid artery, where no collateral vessels existed between the ligature and the sac. "The cases," says Mr. WARDROP, p. 20., "in which this operation was performed, and where the tumour was large, prove, that instead of increasing, in a few minutes after the vessel was tied beyond it, the swelling diminished; a circumstance which was ascertained by the skin covering it, which was tense and ready to burst, suddenly forming into wrinkles."

This principle, therefore, may be received as correct, that a diminution of the impetus of blood in the sac results from a ligature to the artery between it and the capillaries.

The next question regards the degree of diminution, whether it be sufficient to allow of the stagnation and the coagulation of the blood in the tumour? or whether the continued impulse from the heart will prevent the formation of coagula? It is well known, that when an artery is tied at some distance from one of its ramifications, the *vis a tergo* does not prevent coagulation in the *cul de sac* of the vessel, the blood being sufficiently at rest, in such cases, to form the internal conical coagulum noticed by all experimenters and observers. The result of the operations on the carotid seems to prove that this coagulation will ordinarily result also in aneurisms after a ligature beyond the tumour, when no collateral branch is given off between the ligature and the sac, or at the sac itself; including, as M. BÉRARD has well observed, those cases also where, although collateral vessels arise from the sac, they are rendered impervious. The aneurismal dilatation of an artery, therefore, does not prevent the coagulation of blood in the artery and sac, provided no current of blood exists through the sac and any collateral vessels. Hence, BRASDOR's operation promises much in aneurisms of the primitive carotids, as these vessels give off no branches prior to their bifurcation; but even here, it must be regarded as inferior to the operation of HUNTER, or of ANEL, whenever these are practicable, as the diminution of impetus in the sac must, as GUTHRIE maintains, be much less when the ligature is on the cardiac side of the tumour. It is probable that it may be also applicable to aneurisms of the external iliac artery on the same principle, provided the ligature be applied above the origin of the epigastric and circumflex iliac arteries. This has not yet been attempted.

Is the operation of BRASDOR applicable to cases in which collateral and open branches pass off either at the tumour, or between it and the ligature? Will coagulation ensue in such cases? Experiment has taught us, that in ligatures to arteries, no internal coagula form when the current of blood is maintained through even small collateral branches. But in the case of aneurisms, this may be different; inasmuch as coagula form in these sacs in all cases, however active the circulation. These coagula form more readily as the circulation is diminished, and sometimes to such a degree that cures result "spontaneously" by their formation, even when no prior obstruction existed in the artery. Hence it is possible, and even probable, that, when by a ligature to the main trunk beyond the tumour, the impetus of the blood in the sac is diminished, coagula may gradually form, so as eventually to occupy the whole sac and artery, although collateral vessels remained pervious between the aneurism and the ligature. Actual experiment could alone decide the question positively. Mr. WARDROP, believing that this would be the result, and encouraged by the success of the ligature on the carotid artery, boldly made the trial in the now celebrated case of Mrs. Denmark. This female had an aneurism of the arteria innominata, appearing on the tracheal side of the right sterno-mastoid muscle; there was no pulsation in the branches of the right carotid, owing, as afterwards appeared, to the pressure of the tumour on the trunk, while the circulation was active in the right subclavian. On the 6th of July, 1827, a ligature was applied to the subclavian artery above the clavicle, so that the course of the blood through the arteria innominata and sac was intercepted by the obstruction of the carotid artery by pressure, and of the subclavian by a ligature, but might be partially continued through the four branches of the subclavian artery, intervening between the sac and ligature. Notwithstanding this current, the tumour did not increase: her breathing, and the pain in her head were immediately relieved. Soon after being placed in bed, the pulsations of the aneurism became much weakened, and their impulse extended less high in the neck. On the 9th day after the operation, the pulse returned in the right carotid; the swelling had greatly diminished, and, subsequently, the symptoms continued favourable, so that on the 22d day, the patient was able to walk out, and, early in August, to leave London for the country.

At this time, "the wound had healed, and hardly a mark remained to point out the former existence of the aneurism." This patient, during the succeeding winter, suffered severely from thoracic diseases; but on the 8th of August, 1828, no tumour was perceptible in the situation of the former aneurism, but there was a preternatural hardness over the sternum. During the following winter, the aneurismal swelling was again apparent, but did not increase much externally. Nevertheless, symptoms of thoracic disease augmented, the patient's strength failed, and she died exhausted, Sept. 13, 1829, two years and two months after the operation.

In this case, no immediate diminution of the tumour was evident. Nevertheless, its progress was arrested, and although the vertebral, thyroid, mammary, and superior intercostal arteries continued a current of blood through the arteria innominata, coagulation ensued to some extent, and the natural process of cure, by induration and contraction, was so far instituted, that when the carotid became pervious, on the 9th day, the process of obliteration continued until no external vestiges of the tumour remained. This, and the cases of A. Cooper, Evans, and of our distinguished countryman Mott, show that even when collateral vessels exist to keep up a current of blood, the impetus is diminished, and sometimes to such an extent that coagula form more readily in the tumour than before the operation; and that from this increased coagulation, and perhaps from other causes, there may be, and probably will be, a diminution of the size of the aneurism, and not an increase, as has been predicted by physiologists. These are interesting and valuable facts, the result of scientific experiment, and present to us the most favourable and encouraging views as to the success of this mode of operating.

The disadvantages and dangers of Brasdor's *operation* are, however, so great, that these pleasing anticipations are greatly checked. It is liable to the objections which are brought against Anel's operation; especially that the ligature must be applied near the tumour, and on a diseased artery. Hence a liability to secondary hemorrhage exists, from premature ulceration of the artery; the blood being derived, either from the sac, or from the recurrent circulation. This event was the cause of death, in Mr. Lambert's operation on the carotid. The proximity of the ligature to the sac, excites inordinate inflammation in the walls of the aneurism, so that, instead of simple thickening and induration, suppuration, ulceration, or sloughing of the sac may ensue, which will be followed by hemorrhage, should coagula not previously form in the sac. In Mr. Wardrop's first case, ulceration occurred, but fortunately hemorrhage was prevented by prior coagulation. *Again:* As Brasdor's operation is only justifiable, when the aneurism is near the great cavities of the body, the inflammation excited by the ligature will often be propagated, not only to the sac, but to the internal tissues and organs, to the large arteries and veins of the thorax or abdomen, to the pleura, pericardium, or peritoneum, to the heart itself, to the lungs, or intestines, &c. This danger is exceedingly aggravated by the fact, that aneurisms near the origin of the large ramifications of the aorta, are but symptoms or consequences of prior organic disease of the arteries; so that any additional irritation will often be productive of the most unfortunate results.

Some observations seem to be opposed to the idea above maintained, that coagulation may ensue on the application of the ligature: for Guthrie, as well as other authors, relate cases where aneurisms have continued to increase, and have proved fatal, when the lower orifice of the artery has been obliterated by pressure or inflammation; and in some of the operations alluded to, *ultrâ tumorem*, very little improvement was manifested, the disease advancing to a fatal result. Two facts will in a great measure obviate this objection. The first is, that such cases have only occurred where collateral vessels went off from the sac or artery, above the ligature, and where it is probable such vessels were preternaturally enlarged, as is the case when the main trunk is obstructed. But the second and most important fact is, that aneurisms enlarge, not only from the momentum of the blood, but chiefly by the ulcerative inflammation. If, therefore, this destructive process be fully established, it may continue, although the impetus of the blood is diminished; especially as the arteries and sac are in a morbid state, and the attention of the surgeon has not been sufficiently fixed on this point, and, of course, on the necessity for continuing the medical treatment to a certain extent after the application of the ligature. The criticism, therefore, of Mr. Guthrie, on the principles on which this operation succeeds, we think, fails of its object. He maintains, that if the ligature beyond the tumour be ever serviceable, it is so, not by facilitating coagulation of the blood, but by exciting

inflammation in the sac, which terminates in induration, or else, in ulceration, of the parietes of the tumour. His opinion is based on the undeniable fact, that in all these cases evidences of inflammation exist: such as induration, thickening, condensation, or else, suppuration, ulceration, or sloughing. It should, however, be remembered, that this inflammatory excitement exists prior to the application of the ligature, and, when severe, constitutes, as we have endeavoured to prove, the chief reason why any operation is requisite. If, therefore, the ligature should aggravate this inflammation, its influence would be in every respect injurious, as has been already stated. It is absolutely necessary for the safety of the patient, that this excitement should be diminished, so that the adhesive may, if possible, be substituted for the ulcerative inflammation; or, at least, that ulceration should be moderated, until the orifices of the sac and artery become obstructed by coagula, before the sac is opened; otherwise, hemorrhage and death will follow. Reference to the histories of the cases in which Brasdor's operation was performed, proves, undoubtedly, that whenever the ligature was altogether ineffectual, the inflammation was active, and usually aggravated; and in all the cases benefited, the inflammatory symptoms were restrained, and, in some cases, completely removed: also, that when relapses occurred, indications of phlogosis were again manifested.

Mr. Guthrie seems to intimate, also, that inflammation not only precedes, but in some way causes, coagulation of blood in the sac; but it is not easy to conceive of any necessary connexion between the coagulation of blood in the sac, and the inflammation of its parietes. The coagulation of the blood is dependent on its partial or complete stagnation, which has been shown to be the result of the ligature, even beyond the tumour. Coagulation having occurred, and the inflammation being moderated by the diminution of the momentum of the blood, seconded by antiphlogistic measures, the parietes of the sac will usually become thickened by the effusion of lymph, instead of being further thinned by ulceration; or, should ulceration continue, its progress will be lessened. This is the process of cure, whether purely spontaneous, or through the assistance of science.

From the foregoing observations, it may be inferred,

1. That Brasdor's operation is in all respects inferior to Hunter's, or Anel's mode, and should, therefore, never be substituted for them, when these are practicable.

2. That a ligature beyond the tumour will not unfrequently effect a complete cure, when no collateral vessel passes off between the ligature and the sac, or at the tumour.

3. That an amelioration of the symptoms may often be effected when such collateral vessels are given off; and it is possible, that even in such cases, radical cures may result.

4. That the dangers of this operation are always very great, from the diseased condition of the artery, of the larger trunks from which it may arise, and even of the heart; from the proximity of the ligature to the tumour, and from the continued (although diminished) impulse of the blood, exciting or keeping up inordinate inflammation.

5. That hence, this mode is not justifiable in cases where medical means alone will answer, nor where the aneurisms are stationary; but it is alone proper, where the life of the patient is imminently in danger.

6. That whenever employed, it should not alone be confided in, but every possible assistance be afforded, after the application of the ligature, by the medical means at command, that inordinate inflammation may be prevented, and the original diseases of the patient diminished as much as possible. It is evident from the history of the operations, that this precept has not by any means received the attention it deserves; probably from ignorance of the proper principles involved.

7. That the profession and the public are under great obligations to Mr. Wardrop, for reviving this operation, which affords another hope of escape, in cases otherwise desperate.

§ II. Traumatic Aneurisms. These arise, as has been already mentioned, from a wound, rupture, or ulceration of a healthy vessel, so that the parietes of the tumour are formed, not by the arterial tunics, but by the cellular sheath of the vessel, or other surrounding tissue. All their peculiarities depend on the circumstances above indicated; particularly, that the artery is free from morbid action or predisposition, and that there is a solution of continuity in all its coats, as the original and essential cause of the disease. Being formed, their pathology, progress, terminations, and treatment, are so analogous to those of spontaneous aneurisms, that few observations will be requisite in exhibiting the modifications of this form of the complaint.

Traumatic aneurisms constitute the "*false* aneurisms" of many authors, and should be considered as precisely the same affection; although the term *false* has been also applied to the second stage of spontaneous aneurisms, when rupture or ulceration of one or all of the arterial tunics has occurred.

They may result from ulceration; and hence may be the consequence of an erysipelatous, phlegmonous, or other inflammation near an artery; of a gun-shot or other sloughing wound, on the detachment of the sloughs; or of a severe contusion interesting an artery; but they usually arise from wounds, and, almost universally, from punctured wounds of these vessels. For the phenomena and consequences of wounds of arteries, the modes by which hemorrhage is naturally or artificially arrested, and the subsequent changes in the injured vessel and its dependencies, reference must be had to another article (*Arteries.*) But we must notice, at this time, some of those phenomena and consequences, which belong, according to all authorities, to aneurisms.

After wounds of arteries, aneurismal tumours sometimes form immediately, from the effusion of blood into the cellular sheath of the artery, or the cellular tissue generally. These are termed, "*false primitive aneurisms*," "false diffused aneurisms," or "primitive traumatic aneurisms." In other cases, no indication of aneurism is observed for some days, or even for weeks, after the accident: in such instances, the blood is not effused extensively, the tumour is more defined, and is termed a "circumscribed false aneurism," a "false consecutive aneurism," or a "circumscribed traumatic aneurism." Again; when a vein and artery contiguous to each other, are simultaneously punctured, the coats of the vein may form, in whole or in part, the parietes of the tumour: the complaint is then termed, a "varicose aneurism," or, "an aneurismal varix." These constitute three varieties of false or traumatic aneurism, to be separately considered.

1. "*Diffused traumatic*, or *false*, *aneurism*," is usually the consequence of a punctured wound of an artery, in which the blood, being prevented flowing externally, from the smallness of the wound, or the alteration in the relative position of the tissues, is effused into the cellular membrane. It occurs, not only from punctured, but from ruptured, or ulcerated arteries, however induced; and hence, is said to occasionally result from the slipping of a ligature from a divided artery, or from its too rapid separation by ulceration, the external wound being, in either case, closed. If the blood has a free exit through the skin, or into any of the large cavities of the body, the patient suffers merely from the loss of blood; but if the external orifice be small, if the tissues glide over each other, and especially, if moderate pressure be made, so that the blood cannot flow externally, and if the orifice in the artery remain patulous, the blood is injected into the cellular tissue, with an impetus dependent on the size of the artery, and the force of the circulation. This impetus is often so great, that all the tissues of a limb become distended, the small and large vessels are compressed, and the circulation being impeded, the limb becomes cold, and sometimes speedily sphacelates. This event is hastened by the compression of the nerves of the limb, and by the debility produced by the loss of blood. When the impetus is not so great, portions only of the cellular tissue are injected, and over the wound in the artery, a diffused swelling is perceptible, which has an indistinct vibrating thrill, or pulsation.

Diagnosis. The nature of the complaint is generally easily ascertained, by the effusion of arterial blood externally, at the time of the accident, by attention to the course of the wound towards a large artery, by the immediate distension of the part, by the steady yet rapid increase of the swelling, by the firmness of the tumefaction, with an absence of inflammatory induration, by the aneurismal thrill over the wound in the artery, by the skin preserving generally its natural colour, for some time, and eventually becoming discoloured, as in cases of common ecchymosis, and, finally, by the indications of the loss of blood, in the activity and force of the circulation.

When it results from rupture of the artery, or when the vessel is deeply situated, no blood escapes externally; but the remaining indications are generally apparent, so that little difficulty in diagnosis is experienced.

Prognosis is usually unfavourable, especially when an artery of the first magnitude is involved, or when the injury is near a large collateral branch. This arises from several causes, but particularly from the wound in the artery remaining pervious. It may be temporarily closed by a coagulum of blood or of lymph, but permanent adhesion of its lips does not occur without obliteration of the artery. Hence, the injection, and consequent distension, with all their evil consequences, are con-

tinually on the increase, until the circulation is arrested, and mortification succeed.

In some instances also, especially where there is a wound in the integuments, acute inflammation ensues, which is usually very destructive, from the distension of the tissues, and the presence of coagulated blood, especially when, from the access of atmospheric air, decomposition of the blood takes place, aggravating all the symptoms. The danger is enhanced, when the artery is deep-seated, under strong fasciæ, or when the wound occurs near the trunk of the body.

Spontaneous cures may occasionally ensue, where the injured artery has become impervious, from the formation of coagula, and subsequent inflammation and adhesion of its sides. Further effusion not occurring, the coagulated blood will be gradually absorbed, and the evil consequences of the distension disappear. Such cases are not to be expected in the ordinary course of practice, and always, it may be asserted, involve the obliteration of the artery. (Velpeau, Boyer.) Exceptions to this observation, if any, are exceedingly rare. Of course, the prognosis is very unfavourable, where a diffused aneurism (extensive ecchymosis) ensues on the rupture or rapid ulceration of a spontaneous or circumscribed aneurism, before an external tissue is involved: an accident which occasionally occurs.

Treatment. As this complaint, if left to nature, is almost "necessarily fatal," when arteries of the first or second degree of magnitude are concerned, the proper mode of management becomes of the utmost importance. The first and chief indication, is to arrest the hemorrhage; then, the evil consequences of the accident must be carefully considered and relieved.

Compression has been strongly recommended, to check the flow of blood from punctured arteries, especially when it was supposed that the orifice in the artery, being closed by a coagulum, would eventually cicatrize, without obliteration of the tube. Experience, however, is opposed to this practice, excepting when the artery is small, superficial, or situated directly over a bone; in such cases, firm pressure may be continued until obliteration of the vessel ensues. But in all severe cases, compression is useless and injurious: *useless*, as the artery cannot be kept secured, when deep-seated among the tissues; hence, hemorrhage is often but partially arrested, or it very speedily returns, and no obliteration of the vessel ensues: *injurious*, as impeding still further the circulation in the small and large vessels, as aggravating the dangerous tension of the limb, and exciting irritation and inflammation, in parts already injured and predisposed to gangrene. Boyer thinks, that this danger of inflammation and mortification is particularly great, when pressure is made over the wound. Hence, he recommends, should this practice be adopted, that the compresses be applied over the artery above the injured portion, the cellular tissue being previously emptied of blood, by pressure with the finger.

Ligature. As in ordinary cases of arterial hemorrhage, dependence must be placed on ligatures to the artery. The mode in which they should be applied, depends on the circumstances of the case. If the accident be recent, the hemorrhage and consequent infiltration of the cellular tissue continuing, the artery must be exposed, and two ligatures be firmly applied, *secundum artem*, above and below the orifice. This apparently simple operation is generally of difficult execution, and sometimes can scarcely be executed by the most experienced and resolute surgeon. The difficulty arises from the injection of the cellular tissue, muscles, &c., with blood, by which their usual anatomical relations and character are exceedingly altered; and, also, from the obliquity of the original wound, the uncertainty of the vessel injured, its deep situation, its being covered by large masses of muscles, or protected by bone. Surgeons have hence recommended, even at the present day, that in all cases, the operation of Hunter, or of Anel, should be substituted; and some even prefer the amputation of the limb. Guthrie, *inter alios*, has, however, shown that securing the artery above the wound is not adapted to "diffused aneurisms," especially those arising from wounds, because secondary hemorrhage from the injured portion of the vessel almost invariably follows. This hemorrhage, according to his experience, occurs much more frequently from the inferior orifice, and may then be recognized by its flowing in a more equable stream, and by its venous character. It is not so easily arrested by nature. Should such hemorrhage supervene after the main trunk had been secured above the wound, a ligature to the lower portion of the vessel is required, and must now be applied under very unfavourable circumstances, the tissues being irritated and inflamed. This ligature even may not be sufficient, as the upper orifice may pour out blood, in consequence of collateral vessels between the wound and the

ligature on the trunk, demanding other ligatures, or even amputation, for the preservation of the patient.

The Hunterian operation for aneurisms is not, therefore, applicable to wounded arteries or to diffused aneurisms where hemorrhage continues, provided the artery can possibly be secured at the place of injury. This is generally practicable to the well-instructed and experienced surgeon. He should discover what vessel is injured, by examination with a probe; but especially by studying the anatomical relations of the wound, and the direction in which the instrument passed. He should then make an extensive incision through the integuments, taking the wound as his guide if the external part be near the vessel, otherwise over what he knows to be the course of the artery. The cellular tissue is to be carefully dissected, and, as much as possible, emptied of the effused blood. Muscles are to be turned aside, if convenient, otherwise they may be freely divided (GUTHRIE); and occasionally it may be proper even to remove portions of bone, so that the bed of the artery may be exposed and the vessel found and secured. If, however, from the location of the artery, or from the injection and alteration of the tissues by effused blood, this operation be impracticable, and the hemorrhage continue, the surgeon should secure the main trunk above the wound, and repress the secondary hemorrhage by judicious attempts to facilitate the formation of coagula. (Vide *Hemorrhage.*) These means failing, the amputation of the limb may possibly preserve the life of the patient.

When endeavouring to find wounded arteries, the surgeon should seldom apply a tourniquet. Pressure on the main trunk, by an assistant, will usually be sufficient to check dangerous hemorrhage; but occasionally, when the patient is much exhausted, the tourniquet is required for a short time, to save the effusion of blood and the strength of the patient. Its use, however, should be discontinued as soon as possible. In dressing the wound, no compresses or bandages are to be employed, or pressure in any manner be made on the wound or the limb, as there is great danger of mortification from a defect of circulation in the collateral vessels. This danger arises chiefly from the turgescence of the tissues, caused by the effused and coagulated blood, and also from another cause, peculiar to this form of aneurisms. In spontaneous aneurisms, there is a gradual development and enlargement of the capillaries and collateral vessels before complete obstruction has occurred in the main trunk; hence, when such obstruction does ensue, the inferior parts of the limb are more readily supplied than in cases of wounds, or diffused aneurisms of the arteries, where no such enlargement exists. Great importance has been attached to this idea; but experience would show, that however speedily the principal artery is secured, mortification seldom results from this cause alone. When the femoral artery has been tied or divided near the groin, mortification has resulted, particularly when the vein is at the same time obstructed. (GUTHRIE, p. 337.) VELPEAU, however, has lately secured the external iliac artery above the epigastric artery, for a wound of the femoral artery, and no mortification ensued.

Subsequent to the operation, other dangers arise from the disposition to gangrenous inflammation, and also from the premature detachment of the ligature. Inordinate excitement must be prevented or relieved by appropriate measures; but on the occurrence of secondary hemorrhage under these circumstances, another ligature is to be applied, not at the wound, where the artery is inflamed, but at a short distance above, where the vessel is sound. Such operations must often be repeated: they are occasionally successful; but amputation is sometimes requisite for the preservation of life.

Diffused aneurisms are sometimes complicated with fracture of the bones. The dangers already described, when combined with those from fracture, are so great that many surgeons recommend immediate amputation as the safer plan; and this practice is sometimes imperiously demanded, especially when the vein and nerve are injured, or the tissues much lacerated. Ordinarily, however, the operation may be postponed. In compound fractures, there can be no hesitation in exposing the artery at the injured portion, and securing it by two ligatures, as above directed. More doubt exists as to the proper course in cases of simple fractures, where the hemorrhage continues and the tissues are becoming injected. The great aggravation of the danger, arising from converting a simple into a compound fracture, and from exposing a cavity filled with effused blood, liable to putrefaction, would usually forbid the securing of the artery at the wound. The Hunterian operation should here be adopted, and the artery tied a short distance above the injured spot. As there is no external communication, there would be less danger of the bleeding from

the collateral vessels, and coagula for the arrest of the hemorrhage would form more readily, especially as the momentum of the blood would be diminished by the ligature.

The above practice is demanded where hemorrhage is not arrested, and when the blood is effused either externally or into the cellular tissue; but the surgeon is often called when the bleeding has been checked by pressure, and coagulation has occurred at the orifice in the vessel. In such cases, no operation should be immediately performed. (Physick.) Rest, position, and strict antiphlogistic measures, are demanded (see *Hemorrhage*, *Wounds of Arteries*), to favour the obliteration of the vessel by the inflammatory process. Should these fail, or, should the coagula become displaced, a "false circumscribed aneurism" will be formed, less dangerous and more manageable than the diffused aneurism.

2. *Traumatic*, or *false*, *circumscribed aneurisms*, termed also "*sacculated* or *encysted aneurisms*," "*circumscribed hemorrhagic tumours*," are much more analogous to spontaneous aneurisms than the variety just described. They are formed subsequently to the immediate arrest of the hemorrhage from a wounded artery, by the formation of coagula or by pressure. When the bleeding has been temporarily checked, the surrounding cellular tissue, the sheath of the vessel, and even the orifice in the artery, are filled with coagula of blood; and if the arrest has been for any period, coagulable lymph is secreted and the parts agglutinated. Hence, when from the removal of pressure, or from the detachment of the coagulum occupying the orifice in the artery in consequence of the excited condition of the circulation, the motions of the limb, or any other cause, blood again escapes from the artery, it can no longer be diffused in the cellular tissue, but is retained or "circumscribed" at the injured spot. The impetus of the circulation distends the sheath and its envelopes; inflammation, of a moderate type, supervenes, so that a cyst or sac is regularly formed, as when balls or other foreign matters become encysted; the orifice in the artery continues open, and its edges are smooth and rounded by the process of inflammation and absorption. In this condition it presents all the common symptoms of "spontaneous aneurism."

Peculiarities. A circumscribed traumatic aneurism differs, however, from a spontaneous aneurism in several particulars besides the mode of its formation. The artery is healthy; the orifice is smaller in proportion to the size of the tumour, and remains generally stationary or nearly so; the parietes of the sac are always adventitious, never involving any of the arterial tunics; the coagula of blood in its cavity, although sometimes arranged in fibrinous laminæ, are often found in uniform masses, sometimes soft, occasionally hard; they are frequently in contact with the parietes of the sac, but sometimes are covered by fluid blood. Occasionally, in traumatic aneurisms, there is a peculiar thrilling or whizzing sensation, perceptible by auscultation or by the touch, which is attributed to the blood passing through a narrow orifice into the sac. The progress, *cæteris paribus*, is more tedious (Boyer), being in many instances nearly stationary for a long period, sometimes increasing slowly, but at length advancing rapidly to a fatal termination. This slow progress seems to depend on the fact that no solution of continuity is effected at this time by ulceration; and its subsequent rapid development, on the establishment of the ulcerative inflammation. Other explanations have been given: the stationary condition of the tumour has been attributed to the diminutive size of the opening in the artery, and its more speedy increase to the enlargement of this orifice, or to the rupture of the aneurismal cyst. (Marjolin and Bérard.) These views are, however, inadequate and unsatisfactory, as there is no proof of such enlargement of the communicating orifice or rupture of the sac. Dissection manifests very generally the relatively small size of the opening; and rupture of the aneurism would merely convert a circumscribed into a diffused aneurism ("consecutive diffused aneurism") with all its peculiar symptoms, and would not, therefore, account for the regular although rapid development which occurs in the latter stages of the traumatic circumscribed tumour. The difference in this, as in spontaneous aneurism, is dependent on the degree of inflammation; when this is moderate, the tissues are thickened by the effusion of lymph, and resist the dilating force; when, from violent exertion, a blow, febrile excitement, or other cause, it is aggravated, the progressive or ulcerative absorption ensues, or at least is accelerated.

The *Diagnosis* of traumatic aneurism is, therefore, similar to that of spontaneous aneurisms, as regards other tumours with which it may be confounded. To distinguish it from a spontaneous aneurism, we cannot trust to the existing symptoms, as none of them, not excepting the peculiar thrill of traumatic aneurisms, are suffi-

ciently distinctive. We depend on the history of the case ("commemorative signs"), especially the patient having been previously healthy; other arteries being still in a perfect condition; and the present tumour being evidently the result of a wound of the artery. In some traumatic aneurisms, the cicatrix of the original wound will be apparent on or near the tumour; in other cases, it may exist on the opposite portion of the limb; and sometimes, as in cases originating from simple fractures, no scar can be perceived.

The *Prognosis* is generally unfavourable, as natural cures are of rare occurrence, the tumour usually advancing, by dilatation and ulceration, until effusion of blood and death ensue. It is, however, more favourable than in spontaneous aneurisms, as the development of a traumatic aneurism is slower; the artery affected being healthy, there is less predisposition to ulceration; and the disease is isolated, other arteries being in a normal state and no other aneurism existing in distant parts. Hence the treatment is more efficacious, accompanied with less risk, and is seldom followed by secondary hemorrhage or by the formation of internal or external aneurisms.

Treatment. From the account above given, it results that the indications for the treatment of "traumatic circumscribed aneurisms," and the means at command for fulfilling the indications, are precisely the same as in spontaneous aneurisms; but more favourable results may be anticipated, as well from medical as surgical measures.

Medical treatment should, however, never be trusted when an operation is practicable. In other cases, it will be useful on principles already indicated, in retarding the progress of the tumour, and sometimes in effecting a cure. Successful cases are on record, especially from the practice of Baron LARREY. SABATIER succeeded, by means of bleeding and refrigerants, in curing a circumscribed traumatic aneurism below the clavicle. As in spontaneous aneurisms, medical means facilitate the good effects of surgical measures; and, thus conjoined, medicine and surgery will succeed in cases in which either alone would fail.

Surgical Treatment. Compression on the tumour, on the artery above, or below, the swelling, or on the whole limb, is liable to the same objections in traumatic as in spontaneous aneurisms; and the danger is perhaps greater, as the collateral vessels are usually not so much developed. No reliance, moreover, ought to be placed on pressure as a remedial measure, as it has so generally failed in preventing the formation of the disease; and in no case can any permanent advantage be expected, unless it be so powerful and so protracted as to cause obliteration of the artery. MARJOLIN and BÉRARD state that aneurisms have resulted years after the accident, from the displacement of the lymphatic clot at the orifice in the artery; and GUTHRIE attributes a case of carotid aneurism to the imperfect character of the cicatrix of the artery. The requisite degree of compression can seldom be tolerated, although cases are on record from ARNAUD, SAVIARD, PETIT, DUPUYTREN, &c., in which compression has been effectual even on large arteries.

The *Ligature* is the main dependence of the practitioner. Its proper application is very generally successful; more so than in spontaneous aneurisms, as no other aneurisms exist, all the arteries are healthy, and morbid predispositions are absent. Secondary hemorrhage, inflammation and gangrene of the sac, and erysipelatous or phagedenic inflammations, are hence more rarely observed. It has been supposed that there was more liability to mortification from defect of circulation in the parts below the ligature; but experience has obviated this objection, demonstrating that judicious attentions being paid, the collateral circulation is adequate, with very few exceptions, to maintain the life of the limb in circumscribed traumatic aneurisms.

Much debate has also existed as to the relative advantages of the three modes of operating: "the ancient mode," "ANEL'S," or "HUNTER'S mode." There can at the present day be little doubt that in these cases the question is of far less importance than as it regards spontaneous aneurisms, where the vessel, &c., is in a morbid state. Nevertheless, the relative value of these methods is unchanged in traumatic aneurisms. To lay open the sac and secure the artery above and below, is of comparatively difficult execution, and is necessarily followed by suppuration of the sac, and often by ulceration and gangrene from exposure of a bloody cavity ("foyer"). The securing the artery by a single ligature above and near to the tumour, may very frequently be executed, as the artery is healthy and secondary hemorrhage seldom occurs. It has also been urged in favour of this mode of operating, that a smaller number of collateral vessels from the main trunk will be involved, and no portion of the artery between the ligature and sac will be pervious. HUNTER'S operation is on the whole

preferable when it can be accomplished, as the ligature being farther removed from the sac, there is no danger of its exciting inflammation, often of a dangerous character, in the aneurismal tumour, while every other indication will be fulfilled without any reason to apprehend mortification from defective circulation. MM. Marjolin and Bérard would prefer the ancient operation in cases where the tumour was inflamed and ready to ulcerate, or where a fissure had actually formed, as in such cases secondary hemorrhage would occur from the sac almost immediately. The danger however of applying ligatures at the sac is so great where actual inflammation exists, that, other circumstances not forbidding, two ligatures might be applied, one above and the other below the sac, and at such a distance as to avoid the inflamed portion of the artery; an operation less dangerous than the ancient method, even when subsequent rupture or ulceration of the sac occurs.

"Brasdor's *operation*," under the restrictions already laid down, may be performed for traumatic aneurisms which defy medical measures and the usual modes of surgical treatment, and which are decidedly and dangerously increasing. Under such circumstances, more may be expected than in spontaneous aneurisms similarly situated, as there is less danger of secondary hemorrhage, and of inflammation of the sac, from the natural condition of the artery at the tumour.

The patient's system should be previously regulated, all local or general excitement being removed, and the effects of the ligature beyond the tumour be most carefully assisted by "medical means."

3. *Varicose Aneurism.*—It has already been intimated that the parietes of an aneurismal swelling are sometimes partially or completely formed by the coats of a vein, which in such cases become more or less dilated, as in the disease termed Varix (q. v.). This complication of aneurism and varix, is denominated "*aneurismal varix*," or "*varicose aneurism*," according as the symptoms of the former or the latter disease are prevalent. It was first minutely described by Dr. Wm. Hunter, in the year 1757, who succeeded in arresting the attention of the profession, although able writers, particularly Sennert and Guattani, had described analogous cases. Hunter, however, not only described the symptoms, but illustrated and explained their character by dissections. Subsequently it has been frequently observed, and is now well understood.

Mode of formation. Aneurismal varix is very generally the result of a punctured wound, transfixing a vein and interesting also a neighbouring artery: an accident most frequently occurring at the elbow, from the common operation of venesection, in which the lancet, passing through the basilic, or median basilic vein, enters the brachial artery, situated on the inside of the biceps flexor cubiti. The wound of the artery is not always immediately recognized by the operator, but is commonly manifested by the forcible discharge of arterial blood, in jets synchronous with the pulsations of the heart. Some ecchymosis and even tumefaction occur, and "a diffused aneurism" may occasionally form; but generally some pressure is made; the immediate flow of blood from the artery externally, or into the cellular tissue, is arrested, as also the course of this fluid in the vein, this vessel being pressed against the artery and other subjacent tissues. Adhesive inflammation follows; the wounds in the skin and in the external wall of the vein cicatrize; the cellular tissue between the artery and the vein is condensed; and the two vessels are agglutinated around the orifices, in the posterior part of the vein and in the anterior portion of the artery. These orifices would also close, and both artery and vein be obliterated, if the pressure be sufficiently great and long continued; but usually the *vis a tergo*, from the heart and arteries, keeps up the flow of blood in the artery, and as soon as the pressure is removed, impels this fluid directly into the vein from the artery, through the corresponding orifices, displacing any coagula of blood or lymph which may have formed. Thus driven with impetus into the vein, the blood distends this vessel directly over the point of injury, so as to form an irregular swelling of an oval form, containing venous and arterial blood. The tumour thus formed becomes more prominent for a short time, but the swelling soon extends along the vein, slightly towards its radicles, but chiefly towards the heart in the direction of the venous circulation. The vein from this impetus becomes irregularly distended for several inches, and assumes the appearance and characters of a varicose vein, the tumefaction being greater over the original wound. This form of the complaint is termed "*an aneurismal varix*," the appearances of a varix being prominent; no circumscribed tumour existing, and the

blood passing directly from the artery into the vein from the close adhesion of these tubes.

It sometimes, however, happens that much cellular or other tissue intervenes between the artery and the vein, and that the blood from the artery is effused into this tissue before it reaches the orifice in the vein. In these cases, the impetus is often sufficient to distend the cellular tissue as well as the vein, thus giving rise to a circumscribed traumatic aneurism between the artery and the vein, communicating by distinct orifices with each tube, and attended by a varicose condition of the vein. This is termed "a varicose *aneurism*," in which the symptoms of aneurism are predominant, but complicated with those of varix.

The *peculiarities*, therefore, of both forms of this complaint, consist in the vein forming a part or the whole of the walls of the aneurism, while the blood is not confined, but returns into the general circulation by means of the vein, which conveys arterial blood from the artery, and venous blood from its own radicles.

Progress. Aneurismal varix, when completely formed, undergoes few changes. The distended vein becomes somewhat thickened, and resists effectually the impetus from the artery. The ulcerative inflammation seldom, if ever, occurs, as the blood is readily returned to the heart, and the degree of pressure from the *vis a tergo* is thus diminished. Hence the appearance and condition of the vein will usually remain for many years unaltered. The brachial artery, when the disease is at the inside of the tendon of the biceps, enlarges, while the arteries below its bifurcation diminish in size, according to Hunter, Boyer, p. 180, and others; but Breschet, Richerand, &c. have found these vessels enlarged, thinner, and weaker, so as to resemble venous tubes. The muscles and other tissues of the forearm also dwindle, and seem in some measure to lose their tonicity. The cause of these changes has not been satisfactorily explained, but would appear to be connected with the loss of arterial blood through the communicating orifices with the vein. The inferior portions of the limb do not therefore receive their requisite supply, and of course their nutritive functions are imperfectly exercised. The enlargement of the brachial artery seems to depend on that general law of the circulation, that wherever blood is wanted, to that point it is determined, with a corresponding enlargement of the supplying vessels. This is observed, as has already been remarked, in all aneurismal limbs, and wherever a large artery is obstructed; so also in the growth of tumours, in the development of the tissues and organs in childhood, and in all inflammatory diseases.

In *variose aneurism*, unpleasant consequences are more to be apprehended, for the blood, partially stagnant in the tumour between the artery and the vein, coagulates. The swelling thus becomes indurated; it cannot be dissipated by pressure, and interferes with the motions of the limb, and with the functions of the nerves and blood-vessels. Ulceration may also ensue, with the same consequences as in circumscribed aneurisms. Nevertheless, such effects are very uncommon, as the pressure and consequent irritation are constantly relieved by the escape of blood into the vein.

Symptoms and diagnosis of this variety of aneurism are generally well marked. Much is learned from the history of the accident. The varicose condition is usually confined to the vein injured, extending chiefly in the direction of the vessel towards the heart, and slightly downwards, the dilatation being greater directly over the injured spot, and of an elliptical form. A cicatrix may often be seen on or near the swelling. The tumour is of a blueish colour, and in cases of aneurismal varix can be completely emptied by pressure, but returns as soon as pressure is removed. In varicose aneurism the vein may be emptied, but a tumour may then be distinctly felt between the artery and the vein. In both cases there is an imperfect or vibratory pulsation, synchronous with that of the arteries, and the passage of the blood through the communicating orifices is attended by a peculiar thrilling or whizzing sensation, discernible by the touch and ear, which has been variously described. The size of the tumour and the veins, and this vibratory pulsation, are enhanced by a dependent, and decreased by an elevated, position; they are augmented by pressure on the vein above the swelling, and but little influenced when made below. Compression on the inferior portion of the artery aggravates the pulsation and swelling; when made on the superior portion, they diminish or cease entirely. If a ligature be applied around the limb and below the tumour, so firmly as to arrest the arterial and venous circulation, no perceptible impression is made on the swelling; the varicose condition remains. If pressure, under these circumstances, be made on the

dilated vein, the swelling disappears, but returns as soon as the pressure is removed, proving that a direct communication exists with the artery, as the supply of venous blood from the inferior portion of the limb is prevented by the circular ligature. In varicose aneurism, the peculiar thrill is observable as in aneurismal varix; but if the vein be emptied by pressure, with the finger, the pulsation of the tumour between the vein and artery is of a simple character, as in other circumscribed aneurisms.

Not much inconvenience is experienced in the limb, from this form of the disease; the muscular powers are, however, more feeble: there is often a sense of fatigue from slight exertions, and a feeling of engorgement or fullness of the vessels: the size of the limb, from the deficient supply of blood, or from want of its usual exercise, is diminished, and the motions are not unfrequently impeded when much alteration of the tissues has been produced at the joints.

The *Prognosis*, therefore, is not unfavourable; there is no danger of rupture in the aneurismal varix, and very little probability of this occurring even when a circumscribed tumour exists. There is, indeed, little tendency to change, after the disease is fully formed; and, excepting from the sensations of fullness and weakness, the patient suffers little inconvenience, even after the lapse of many years. Spontaneous cures never occur, and there is no natural tendency to diminish or arrest the progress of the complaint, unless an aneurism be formed between the artery and vein. In these cases, it is possible for a cure to result in the same manner as in spontaneous aneurisms; but this result is not to be anticipated, as the blood is not confined, but passes readily through the sac into the vein.

The history above given applies chiefly to aneurisms at the bend of the elbow, from the operation of venesection, but is almost equally true of varicose aneurisms in other situations, however produced. They have been observed in the ham, in the thigh, at the groin, at the axilla, and in the neck, produced usually by punctured wounds, but occasionally from gun-shot or other contused wounds, and in one case from a puncture with a hot poker. Of course, their mode of formation varies according to the kind of wound inflicted; in gun-shot wounds, for example, the ball may pass between an artery and a vein, injuring both tissues: on separation of the sloughs, the blood may pass from the artery into the vein, while the wound or wounds in the integuments heal. It is said that this variety of aneurism has occurred spontaneously, in consequence of an ulceration between the corresponding parietes of an artery and a vein. A case of the kind is recorded by Mr. J. Symes, of Edinburgh, between the aorta and inferior cava.

The symptoms and prognosis are somewhat modified by the situation. When on the neck, the passage of the blood in the vein is facilitated by gravity, and comparatively little distension and inconvenience result. In the lower extremities, on the contrary, the influence of gravity in retarding the course of the venous blood, and in facilitating the arterial circulation, augments the varicose condition of the vein: hence the feelings of engorgement, weariness, and feebleness, are augmented, and the danger of inflammation, and even of rupture or ulceration of the vein, is aggravated. Such results have ensued in common varicose affections, and may therefore occur in this variety, especially if both forms of varix unfortunately coexist in the same limb. Ulceration or rupture in aneurismal varix would prove speedily fatal, without suitable assistance.

Treatment. Medical means, whether general or local, can only moderate the symptoms of aneurismal varix: they have no influence in effecting a radical cure, as blood will always pass from the artery to the vein, however much the force of the circulation may be diminished. There is no stagnation of the blood; of course, no coagulation of this fluid, and no obliteration of the tumour or vessels. These observations are usually applicable to varicose aneurism also; but as in this case there may be such an accumulation of coagula in the sac between the artery and vein, as to obstruct the passage of the blood and thus to effect a radical recovery, the evacuating plan may possibly be useful, but certainly ought not to be trusted.

Surgical means may be advantageously resorted to, when the symptoms are severe or the prognosis dangerous; but in ordinary cases of aneurismal varix, so little inconvenience results that patients will seldom submit to a painful operation, and the surgeon is not justifiable in recommending anything beyond palliative measures. These consist in regulating the force of the circulation generally, and especially in the injured extremity. The patient must avoid a pendent position of the part; all pressure on the upper portion of the limb, especially on the veins; and all sudden or violent exertions. Some occupa-

tion should be selected which will not demand much muscular effort, particularly of the affected member; and resort be frequently had to cold applications to the upper part of the limb, and frictions, to maintain a healthy and more vigorous circulation in the inferior portions. Thus the disease and its inconveniences may not augment during a long life, and the usefulness of the patient be preserved.

Compression. Attempts at a radical cure have been frequently made, and are justifiable when the symptoms are severe, are increasing, or dangerous. Compression has been effectual in some few cases, by causing the obliteration of the artery and vein, and hence was recommended by the older surgeons; but has of late been abandoned, for reasons already stated. (Vide *Spontaneous Aneurism.*) In aneurismal varix, partial compression is injurious, especially as it must produce venous engorgement; and if not so powerful as to arrest the arterial circulation, will cause the blood to accumulate between the artery and vein, so as to form a circumscribed aneurism. If employed as a radical means, it must effect the obliteration of the artery, and hence must be powerful, and applied, *secundum artem*, to the whole of the affected extremity. In this way, it is painful and dangerous. As a palliative, it is often employed to support the veins, and thus to relieve the feeling of engorgement. With this object, a roller should be applied from the extreme points of the limb, with moderate firmness, so as to be agreeable to the sensations of the patient. Much caution, however, is required, and on ordinary occasions this application should be omitted. A sling, to support the arm, is often a convenient and pleasant substitute.

Ligature. The only safe mode of effecting a radical cure is by means of the ligature. This is generally acknowledged; but it is still questioned whether the ancient or the Hunterian operation is preferable. The success of the latter, in spontaneous, and in circumscribed traumatic aneurisms, encouraged surgeons (without sufficient reflection) to imagine that it was equally suited to every variety of the disease. To either form of aneurismal varix, it is inapplicable; for while the patient is exposed to all the ordinary dangers of securing the main artery of the limb, he is here more liable to mortification from the weakened condition of the arteries, &c., below the tumour. Moreover, when the main trunk is secured above the ligature, venous blood, as demonstrated by Breschet, then passes from the vein through the communicating orifices into the arteries below the tumour, and of course increases the liability to gangrene and the difficulty of re-establishing a perfect arterial circulation. Finally, a radical cure is almost impossible; for although the main artery be obstructed, yet the blood at the tumour is not stagnant, passing continually from the vein to the artery, or *vice versâ;* and however much the force of the circulation may be diminished, no coagulation follows, and no obliteration of the communicating orifices ensues. Experience is also opposed to the operation. Drs. Physick and Wistar, in 1804, secured the main artery of the thigh for aneurismal varix of the leg communicating with the anterior tibial artery. Mortification and death followed. (Dorsey's *Surgery.* II. 210.) The same result occurred in an analogous case, to M. Dupuytren; and in three or four other cases, the disease reappeared.

Dupuytren has suggested the idea of securing the vein as well as the artery above the tumour, so as to render the blood stagnant in the veins and at the communicating orifices. This might occasionally be successful, but blood would usually continue to flow from the vein to the artery, or the reverse; and in all cases, the liability to phlebitis will be exceedingly great, as the ligature is applied to a vein in a morbid condition.

The *ancient operation*, of securing the artery above and below the spot injured, is therefore always to be employed when any radical measure is desired. In cases of simple aneurismal varix, it should be performed very nearly in the same manner as when a wounded artery is to be secured. A tourniquet being previously applied to the limb, an incision is to be made over the tract of the artery, which vessel, and sometimes the injured vein, are to be exposed by a careful dissection, and two ligatures, one above, and the other below, the injured spot, be passed under the artery and secured. If any difficulty occur, the vein may be laid open, and a probe passed from the vein into the artery, on which this vessel can be raised. This should, however, be avoided, if possible, because phlebitis will follow, which, if severe and continuous, is exceedingly dangerous, and often fatal; and in all such cases, obliteration of the vein results, impeding the circulation in the parts below. On ordinary occasions, therefore, the artery only need be disturbed, and in no case should a ligature be applied to the vein. (Vide *Phlebitis.*)

In *varicose aneurism*, the operation is very generally demanded, as the tumour may increase, and the patient, of course, is never free from danger. The artery must here also be secured at the injured spot; but experience has hardly been sufficiently extensive, to decide as to the proper mode. Dr. PHYSICK, who in 1802 first performed the operation for this variety of aneurism, dissected around the dilated vein and the aneurismal tumour, so as fairly to expose the artery at the bottom of the wound. Ligatures were applied to the vein, and also to the artery, and the whole mass was removed. (Vide DORSEY's *Surgery*. V. 2. for an engraving and description.) This patient did well, escaping every bad symptom. Mr. PARK, of Liverpool, operated about the same time, with equal success; but laid open the tumour. Surgeons now usually advise, that the vein and the tumour be divided, the coagula be turned out, a probe passed through the orifice into the artery, and two ligatures applied to this vessel. It is manifest, however, that the dangers of the operation are in this way needlessly augmented: first, by the liability to phlebitis from exposure of the vein; and second, by the danger of severe, if not gangrenous, inflammation, from the opening and exposure of a bloody sac. A surgeon, properly instructed and sufficiently experienced, could easily make a neat dissection around and under the tumour, so as to expose and secure the artery above and below the aneurism without injuring either vein or tumour. He would thus materially diminish, if not altogether avoid, the dangers above mentioned, and the wound might heal by the adhesive inflammation, except in the immediate tract of the ligatures. If the tumour, however, be large, or if inflammation of the sac be apprehended, Dr. PHYSICK's practice of extirpating the whole mass, after securing the artery, would be preferable; avoiding, however, the ligatures on the vein, which are unnecessary, for a venous hemorrhage can easily be restrained by pressure, &c., and dangerous, as exciting phlebitis. The wound would then present a simple character, with ligatures to the two extremities of a divided, but healthy artery.

H. L. HODGE.

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I. H.

ANGEIAL. (From αγγειον, a vessel.) Vascular.

Angeial tissue, or *angeial cystous tissue.* M. de Blainville thus denominates the serous membrane, which lines the great reticulated arborescent cavity, in which the lymphatic and sanguineous fluids oscillate and circulate. The vascular system may be considered as a vast sac, with infinite ramifications, the essential element of which is the angeial tissue, other struc-

tures being superadded to this, according to the functions to be performed. Thus, in the heart, where a propulsive power is requisite, this tissue is encompassed by powerful muscular masses; in the arteries, where strength and elasticity are wanted, it is surrounded by the yellow elastic fibrous tissue; whilst in the veins, which have to resist the force of gravity only, it receives a fibrous coat much more delicate and elastic than that of the arteries. This tissue exists in every part of the organism. Its source is the cellular tissue, of which it is but a modification. The smaller the vessels are, the nearer does this tissue approximate to cellular tissue, and it becomes more and more condensed as the vessels it lines augment in volume, until it ultimately attains the characters of serous membrane. (See *Serous Tissue*, *Cystous tissue; Arteries*, *Veins*, *Lymphatics*, *lining membrane of.*)

Angeial cellular, or *areolar texture.* Our erudite friend and colleague, Dr. JACKSON, has employed these expressions to designate that portion of the angeial cystous tissue which exists between the termination of the arteries and the commencement of the veins. It is the immense cellular, reticulated structure which pervades the whole organism, in which the fluids oscillate and circulate, and in which, under the influence of vital chemistry, all the acts of nutrition, the functions of composition, decomposition, and calorification, are effected. The erectile tissue offers, on a magnified scale, a type of this tissue. (See *Erectile Tissue*, *Nutrition*, *Circulation*, &c.) I. H.

ANGEITIS, or ANGITIS. (From αγγειον, a vessel.) Inflammation of the vessels. See *Arteritis*, and *Phlebitis*. I. H.

ANGELICA. (*Botany* and *Mat. Med.*) *Sex. Syst.* Pentandria Digynia. *Nat. Ord.* Umbelliferæ.

Gen. Ch. *Fruit* subcompressed, with three acute winged *ribs;* intervals sulcate; margin membranaceous. TORREY.

1. *A. Archangelica.—Garden Angelica.—Angélique*, Fr.; *Engelwurzel*, Germ. —*Sp.Ch.* "Terminal leaflet lobed." WILLD. *Sp. Plant.* This is a biennial plant, with a hollow, round, channeled, smooth, purplish, branching stem, rising five feet or more in height, and bearing alternate, doubly pinnate leaves, with roundish, fistulous footstalks, which are greatly dilated, membranous, and sheathing at the base. The leaflets are ovate, or ovate-lanceolate, acutely serrate, pointed, and smooth. They are in one or two pairs, with a terminal leaflet, which is lobed. The uppermost leaves are often simply ternate. The flowers are small, greenish-white, and disposed in large, many-rayed, almost globular, terminal umbels, composed of numerous dense, hemispherical umbellets. The involucre consists of one or two caducous leaflets; the involucel is many-leaved. The calyx is minute and five-toothed. The corolla is composed of five pointed petals, with the points turned inwards. The plant is a native of the north of Europe, and of the more elevated regions in the southern portion of that continent. It is cultivated in Europe for medical purposes, and has been introduced into our gardens. It flowers during the summer. All parts of it are aromatic; but the root and seeds only are officinal.

The *root* of the garden angelica, (*Angelicæ Archangelicæ Radix*, PH. E.) is spindle-shaped, from an inch to an inch and a half thick at the upper end, beset with numerous long radicles, of a yellowish-gray colour on the outside, and whitish within. It contains a yellowish juice, which assumes a reddish tinge on exposure to the air, and concretes into a mass bearing some resemblance to opoponax, and having the aromatic properties of the plant. When dried, the root shrinks considerably, becomes much wrinkled, and assumes a dark grayish-brown colour externally. Internally it is of a dirty white colour, and spongy, with an amylaceous fracture, which exhibits shining resinous points. The numerous descending radicles are somewhat twisted together at the lower extremity. As met with in our shops, the root is very often worm-eaten, and partially decomposed. It is said to keep best when collected in the autumn of the first year, though writers generally recommend that it should be collected in the spring of the second. Its odour is strong and fragrant; its taste, at first sweetish, afterwards warm, aromatic, bitterish, and somewhat musky. These properties are strongest in the fresh root. They are extracted by alcohol, and less readily by water. The active constituents of the root are probably its volatile oil, and bitter extractive. The oil may be obtained separate by distillation with water.

The *seeds*, which are directed by the Dublin College, are two or three lines long, oval, obtuse or somewhat notched at the ends, flat and marked with a longitudinal furrow on one side, convex with three angular ridges on the other. They are ash-coloured, and have the same smell and taste as the root. They are said to keep well.

The stalks and leaves, which are aromatic in the recent state, become inert by drying.

The garden angelica is a warm aromatic tonic, employed in Europe, particularly in the northern part, both as a condiment and as a medicine, but very little used in the United States. It may be given as a carminative and stomachic in flatulent colic and dyspepsia, and to qualify the taste and effects of other medicines. For the latter purpose it is used to some extent in the pharmacy of continental Europe. The young stalks are frequently made into a preserve, and eaten at table as a stomachic. The root and seeds may be administered in infusion or powder. The dose in substance is from thirty grains to a drachm.

2. *A. atropurpurea.*—Angelicæ, Ph. U. S.—*Sp. Ch.* "Stem smooth, coloured; leaves ternate; the partitions subquinate; leaflets ovate, acute, incisely serrate, sublobed; the three terminal ones confluent; petioles very large, inflated." Torrey. This species of angelica rises from three to five feet in height, and has a purplish stem, which serves to distinguish it at a distance. It is a native of the United States, growing in meadows and marshy woods, from Canada to the Carolinas. Its flowers, which are of a greenish-white colour, appear in June and July. The whole plant is officinal. It has a strong agreeable odour, when bruised, and a warm, aromatic taste. The juice of the fresh root is acrid: but the acrimony is dissipated when the root is dried.

The medical virtues of the purple angelica are similar to those of the European species; and it is probably upon this ground that it has been admitted into the secondary catalogue of the U. S. Pharmacopœia. It is, however, scarcely ever employed in regular practice. An infusion of the plant has sometimes been found useful in flatulent colic; and the stems are said to be occasionally made into preserves by the country people.

Geo. B. Wood.

ANGIECTASIS. (From αγγειον, a vessel, and εκτεινειν, to distend.) An epithet introduced into medical language by Graefe, and adopted by Alibert, to designate all morbid dilatations of vessels. From it are derived *cardiectasis*, *phlebectasis*, *lymphagiectasis*, and *telangiectasis*, (q. v.) (See also, *Aneurism*, *Nævi Materni*, *Erectile Tissue*, &c.) I. H.

ANGINA. (From αγχω, I suffocate.) κυναγχη, Παρισθμια, Gr.; *esquinancie*, Fr.; *bräune*, *kehlsucht*, Ger.; *schinanzia*, Ital.; *quinsy*, Eng.

The word angina was employed, by the Latin writers, as a generic term for all the inflammatory affections of the posterior fauces; and this in consequence, evidently, of the difficulty of breathing, amounting, in violent cases, to a sense of impending suffocation, which constitutes so prominent a symptom of the inflammations of these parts. By Hippocrates, and the Greek physicians generally, these diseases were denominated *cynanchia*, a word of similar meaning with angina, though in regard to its precise etymology some difference of opinion exists. The term *paristhmia*, or throat disease, is occasionally also applied to the anginose affections by Hippocrates; but by no means invariably, as Dr. Good would seem to infer.

In angina the inflammation is seated in some portion of the mucous membrane enveloping the back part of the throat. It may be confined to the mucous membrane of the soft palate and isthmus of the fauces; to that lining either the pharynx or larynx, or it may affect all of these parts at the same time. The inflammation, in many cases, extends to the tonsils, the parotid glands, or to the muscles of the throat, and it is occasionally propagated to the mucous coat of the trachea and œsophagus. The symptoms by which the disease is accompanied vary, of course, according to the violence of the inflammation, and according as it is seated in one or other, or all of the above parts. The phenomena accompanying the several varieties of angina will be considered minutely under the heads of *Tonsillitis*, *Pharyngitis*, *Laryngitis*, *Tracheitis*, &c., to which the reader is referred.

Angina may occur at every period of life, and in individuals of the most dissimilar temperaments; most commonly, however, it affects young, robust, and plethoric subjects. It is produced by the same causes as give rise to other inflammations; particularly exposure to cold and moisture, when the body is in a state of perspiration, or labouring under fatigue; by cold applied to the feet, or by imprudently laying aside the usual covering worn upon the neck. Inflammations of the throat are most prevalent in cold, damp, and variable climates, and in the spring and autumn, when sudden transitions in the temperature of the atmosphere are the most frequent. Angina is particularly liable to attack females about the age of puberty, or when, during the menstrual periods, the patient is ex-

posed to the influence of cold. Some individuals are so susceptible to its attack, that a very slight reduction of the temperature of the feet, or other parts of the body kept habitually covered, is sufficient to produce it in them. In certain cases, anginose inflammation results from the direct application to the throat of acrid or corrosive fluids, accidentally or intentionally swallowed.

Angina frequently prevails as an epidemic, extending over a large district of country, or occurring simultaneously, or in succession, in portions of the earth widely separated from each other. Epidemics of this kind have been described, with more or less minuteness, by various medical writers, from the early part of the sixteenth century to the present period. In some of these epidemics, the disease presented symptoms of extreme mildness, and in the majority of cases subsided spontaneously within a few days; while in others, the symptoms were of the most violent and malignant character, causing very great suffering to the patients, and terminating rapidly in death. In some instances the inflammation of the throat occurred alone, in others it was accompanied with scarlet fever, severe affections of the stomach and bowels, or extensive swelling and suppuration of the glands of the neck.

Angina assumes occasionally an intermittent form, recurring in the same individual, apparently without any exciting cause, at nearly regular intervals. Thus, some are liable to its occurrence every spring and autumn, or several times in the course of the year.

As we have already remarked, the symptoms of angina vary in different cases, according to the extent of the inflammation, and the particular part of the throat in which it is seated. The disease, however, is almost invariably attended with more or less difficulty of swallowing both solids and fluids; a sense of soreness and fullness, or of pain, in the back part of the throat, with impeded respiration, hoarseness of the voice, and difficulty of articulation. In general, a redness and tumefaction of the fauces, to a greater or less extent, may be detected by the eye.

The pain and difficulty of deglutition are the greatest, and the impediment to respiration the least, when the inflammation is confined to the mucous membrane of the soft palate and isthmus of the fauces; while, on the contrary, the act of swallowing is attended with the least inconvenience, and the sense of suffocation is the most distressing, when the inflammation attacks the larynx.

In the early period of the attack, the parts affected are dry, and present a polished appearance; but after a short period, there, in general, takes place from them a copious exudation of a thick tenaceous mucus, which induces frequent hawking and spitting. When the soft palate is considerably inflamed, the point of the uvula is brought in contact with the root of the tongue, and by the peculiar sensation which it excites, causes the muscles concerned in deglutition to be thrown almost constantly into action, and thus increases greatly the sense of pain and soreness in the throat. From the same cause, frequent nausea or vomiting is excited, or a continual and most distressing cough.

In violent cases of angina, the inflammation of the fauces is attended with acute pain of the throat, shooting into one or both ears, and with the utmost difficulty of breathing; inspiration being accompanied with a loud wheezing sound. Every effort to swallow causes the most intense suffering. The external parts of the throat are swollen and painful to the touch; and these local symptoms are most commonly attended with more or less febrile excitement.

When the whole extent of the mucous membrane of the fauces is occupied by the inflammation, which, however, is rarely the case, the symptoms are always of the most violent character; the progress of the disease is extremely rapid; and unless arrested by a prompt and energetic treatment, its termination is ordinarily fatal. In such cases, there is intense pain and heat of the throat, with vivid redness and great tumefaction of the whole of the posterior fauces. The redness may even extend over the whole cavity of the mouth. The external parts of the throat are, at the same time, swollen and painful. The act of swallowing is extremely difficult, or even impossible; the voice is almost extinct; the respiration wheezing and laborious, and the patient experiences constantly the most distressing sense of impending suffocation. These symptoms are attended with a frequent sharp or ringing cough. The face, in general, becomes red and tumid; the veins of the forehead prominent, and the eyes injected and protuberant. The lips and tongue are often greatly swollen; the latter occasionally projecting beyond the mouth. The respiratory organs are thrown into violent or even convulsive action; and the arteries of the neck pulsate violently. These symp-

toms are ordinarily attended with thirst; increased heat of the skin; a small quick pulse; great anxiety, and more or less disturbance of the mind, amounting often to actual delirium.

The progress and duration of angina are extremely various. In its milder forms, when it attacks only the soft palate and isthmus of the fauces, or is confined to the mucous membrane of the upper portion of the pharynx, it may be considered rather as a painful and troublesome complaint, than one attended with much danger. It often terminates in a few days by a spontaneous resolution, or may be arrested promptly by a very simple treatment.

Guttural angina assumes occasionally a chronic form, particularly in those individuals who have suffered repeatedly from its attacks. In these cases, the patient may experience, for months or even years, more or less difficulty and pain in swallowing; a constant dull pain or sense of soreness and dryness in the throat; cough; hoarseness or an altered tone of voice, with redness and tumefaction, to a greater or less extent, of the mucous membrane of the fauces. Even, however, when the inflammation is confined to the parts anterior to the larynx, the disease is not unfrequently attended by symptoms, or productive of effects, of very considerable violence and danger. But even in such cases, it is perfectly under the control, in its earlier stages at least, of an appropriate treatment. When, however, it is neglected or mismanaged, extensive abscesses may be formed in the tonsils or some part of the soft palate, which, until they are evacuated by artificial means, or by a spontaneous rupture, cause an impediment to respiration, amounting, in some cases, almost to suffocation. When the inflammation in angina extends to the larynx, the patient may be destroyed by it in a few hours. In other instances, death may be caused by extensive ulceration or by gangrene of the throat. But it is not our intention in the present article to enter upon the consideration of the progress and termination of the different varieties of anginose inflammation; for these, the reader is referred to the articles, *Tonsillitis*, *Pharyngitis*, *Croup*, *Tracheitis*, &c. It will be proper, however, to notice cursorily one or two forms of angina, which, of late years, have attracted very considerable attention from several distinguished medical writers.

1. *Angina œdematosa*; the angina laryngea œdematosa of M. Bayle (*Mémoire sur l'œdema de la glotte.* Paris, 1819.); and the angina suffocans of M. Martinet (*Revue Médicale*, 1827.). In many cases of angina, particularly those in which the disease is seated in the larynx, the submucous cellular structure of the parts affected becomes distended with serum, constituting a genuine œdema of the fauces. The serous effusion in these cases is to be viewed merely as one of the effects of a particular grade of inflammation. The mucous membrane covering the parts in which the œdema is seated, assumes a tumid, shining, and pale blue appearance. Angina œdematosa often occurs with great suddenness; and when it takes place in the sub-mucous cellular structure of the rima glottidis, by approximating the edges of the latter, it causes a direct mechanical impediment to the passage of the air into the lungs, and hence the patient is often quickly destroyed by suffocation. The œdema is particularly liable to affect the epiglottis, which is often found to be red, erect, and swollen, having the appearance, during the life-time of the patient, of a portion of raw beef.

This form of angina appears not to have been distinctly noticed by the older writers: previously, at least, to the commencement of the present century, no accurate description of it is to be met with. Since then, however, it has attracted the particular attention of the profession, and we have been presented with numerous observations in relation to it from some of the most distinguished of the English and continental physicians. By the older writers it was no doubt confounded with tracheal inflammation; though it is seldom that in œdematous angina the disease extends below the glottis.

The difficulty of breathing, and danger of actual suffocation, in angina œdematosa, are always in proportion to the proximity of the disease to the orifice of the glottis, the extent of the serous effusion, and the rapidity with which it takes place. The patient, in some cases, is almost immediately suffocated by the entire closure of the rima glottidis, while in others he may suffer for many days, from partially obstructed respiration, and be finally destroyed by the occurrence of extensive congestion in the lungs and brain.

Œdematous angina is occasionally very insidious in its approach. Mr. Porter (*Surg. pathol. of the larynx and trachea*) mentions two instances in which the patients, both young men, retired to bed at night, without complaining of any disease

of the throat, and were destroyed before morning by an attack of œdema of the larynx.

According to M. Martinet, œdema of the glottis may be suspected when there is a sensation experienced as though a foreign body were lodged in the throat, and more especially, when, by the finger, a kind of ring or ridge is felt surrounding the rima glottidis; the patient, at the same time, labouring under extreme dyspnœa.

2. *Angina pseudo-membranosa;* the *angine diphtéritique* of M. Bretonneau, and the plastic angina of other writers.

This is one of the most common forms of anginose inflammation, being that which generally accompanies scarlatina when the latter prevails as an epidemic. It commences often with symptoms of so mild a character, as to attract scarcely any attention on the part of the patient, until the disease of the throat has made considerable progress. The deglutition being but little or not at all impeded, only a trifling soreness, or rather a sense of roughness in the fauces, is experienced, while no febrile excitement is to be observed. In many cases, however, the patient is affected from the very onset of the disease, with a sense of heat or burning in the throat; while in others, the act of swallowing, and the slightest motion of the neck, cause most intense pain; the local symptoms being accompanied with increased heat of the skin, and all the other phenomena of fever.

In whatever manner this form of angina commences, the whole of the posterior fauces becomes quickly covered with irregular circumscribed patches, varying in thickness and consistency, of a white or yellowish colour, and of a smooth, shining, cheesy appearance; and the glands of the throat become, at the same time, more or less swollen and painful. These patches are covered by the epithelium, and adhere firmly to the mucous tissue.

Previously to the formation of the pseudo-membranous exudations in the fauces, the mucous tissue appears red and injected, the capillary vessels being more or less developed, as in simple angina. The redness and injection continue subsequently to the appearance of the exudations, and the membrane is then less moist than natural. The mucous tissue is likewise infiltrated with blood in the form of small clots having a linear arrangement, or of small oblong ecchymoses of a dark red colour: this is particularly the case in the pharynx and soft palate. Occasionally, the mucous tissue presents a few dry, oblong, grayish spots, as though it had been cauterized by an acid.

The exudations increase in extent more or less rapidly; sometimes, in the course of a few hours, the whole of the posterior fauces becomes covered with them. When they cease to enlarge, they become almost immediately surrounded with a reddish line; they then acquire a spongy consistency, and soon separate from the parts to which they were attached, giving rise to a slight discharge of dark-coloured blood which mixes with the saliva. The latter is also, for the most part, frothy and extremely fetid. As the patches separate, in general, a discharge takes place from the nostrils, of a serous, yellowish or bloody sanies, of a very fetid odour; and, sometimes, particularly in adults, a copious epistaxis. In many cases, the discharge from the nostrils is present from the very commencement of the attack.

In general, as the patches become detached from the mucous membrane of the fauces, their place is quickly supplied by a new formation of the same matter, which, however, after each separation is in general whiter and much thinner than previously. This separation and renewal of the pseudo-membranous crusts, continue, in most cases, for the space of eight or ten days, when finally they cease to appear, leaving the mucous tissue to which they had been attached perfectly sound throughout its whole extent; of a light-red uniform colour, and covered with a thick yellow mucus, more or less resembling pus. In other cases, the crusts, instead of being separated in fragments, become in part softened to a pulpy consistence, and are discharged from the mouth mixed with a bloody mucus. As the disease in the fauces disappears, the glands of the throat, provided they are not in a state of suppuration, diminish in volume, and are no longer painful. In no instance has the mucous membrane of the fauces, in this form of angina, been found softened, black, or presenting either the aspect or odour of gangrene. On this point, the observations of Bretonneau, Deslandes, Guersent, and others, coincide.

In relation to the progress and termination of pseudo-membranous angina, nearly the same remarks may be made as in relation to angina in general. When the disease is confined to the soft palate, isthmus of the fauces, and pharynx, it is seldom attended with much danger; yielding readily to an appropriate treatment, or even, when the inflammation is of little extent,

disappearing spontaneously in a few days. But when the disease attacks the larynx, it is productive of very considerable suffering to the patient, and is frequently destructive of life.

The pseudo-membranous exudation is very liable to extend into the trachea and bronchi. This extension of the disease, in some cases, takes place almost instantaneously, on the first appearance of the patches in the fauces; in other instances, the respiratory organs are not affected until about the third, sixth, or eighth day from the commencement of the angina. At whatever period the extension of the disease takes place, the peculiar symptoms of croup are immediately developed, and, in the greater number of cases, the patient is rapidly destroyed. According to M. Bretonneau, croup is produced in all cases, by an extension of the inflammation constituting membraniform angina, from the throat to the mucous membrane of the trachea and bronchi; though we cannot admit that such is invariably the case, we have every reason for believing that croup is more commonly preceded by anginose inflammation than is generally supposed.

Not only may the extension of pseudo-membranous angina to the respiratory organs give rise to croup, but it is also productive, in certain cases, of a species of pneumonia, extremely insidious in its commencement, and marked, in part, by the symptoms which are referrible to the disease of the fauces. The cough, in this affection, is different from that of croup, and is unattended with aphonia; the mucous expectoration is often streaked with blood, while auscultation and percussion give all the indications of a catarrhal engorgement, more or less extensive, of the lungs. (Guersent.)

3. *Angina gangrenosa.* Gangrene of the throat, putrid sore throat, and malignant angina of different writers.

This variety of angina is very frequently met with accompanying scarlatina, particularly in its epidemic form. It may occur previously to the appearance of the eruption upon the skin; during the presence of the latter, or towards its decline. The fauces present the same membraniform exudation as in the preceding variety. In this, however, it is for the most part confined to the mucous membrane anterior to the larynx, over which it is more uniformly spread than is the case in the former. The inflammation seldom, if ever, extends to the trachea or lungs. A sanious, fetid humour runs from the nostrils, and the patient discharges from the throat, at first, a thin bloody mucus, which becomes subsequently puriform, and mixed with shreds of a membranous appearance. In some cases, the discharge from the throat is dark-coloured, almost black, and strongly resembles that from a gangrenous ulcer. The pain and tumefaction of the submaxillary glands are much more considerable than in the preceding form of the disease, and they are also more liable to run into suppuration. The voice is entirely guttural, and the power of articulation is occasionally suspended. In some instances, the respiration is rendered difficult from the extensive tumefaction of the fauces; but the disease is unattended, throughout, by any of the symptoms peculiar to diseases affecting the larynx and trachea.

The progress of gangrenous angina is ordinarily very rapid, the disease often running through all its periods in the space of a week or twelve days.

As in this variety of angina the organs of respiration are but very seldom affected, its favourable or unfavourable termination will, in a great measure, depend upon the nature and extent of the lesions of other organs with which it is accompanied in different cases. When the death of the patient happens during the existence of the anginose affection, the mucous membrane of the fauces is found to be almost uniformly injected with blood, of a violet colour and more or less swollen, but without the ecchymosed appearance noticed in the preceding variety. The membraniform exudation is also less firm and adherent, while the tonsils are softer and infiltrated with mucus and pus. (Guersent.)

Gangrenous angina is met with at all seasons and in every climate. It may occur either sporadically, or as an epidemic. In certain countries and situations, it prevails as an endemic. It may affect persons of every age, but is more commonly met with in children, who are peculiarly predisposed to all the varieties of the anginose affections.

From the foregoing sketch of the leading phenomena of that form of angina to which the term putrid or malignant is most commonly applied, it will be perceived that, strictly speaking, it is unattended with either gangrene or sloughing of the fauces. The fact is, that true gangrene of the throat is of far less frequent occurrence than was generally supposed by the older writers, or is still believed by many physicians of the present day. Actual sloughing of the throat, however, does occur in certain cases of angina, particu-

larly in that form of the disease which is met with accompanying certain epidemics of scarlatina of a very malignant character, and which will be considered when we come to treat of the latter disease.

By nearly all the older physicians, angina gangrenosa was considered to be eminently contagious; and the same opinion is entertained by many practitioners of the present day. In looking over the arguments by which this point is attempted to be established, we find them, however, altogether inconclusive. They are derived entirely from certain endemic or epidemic occurrences of angina, and so far from proving the propagation of the disease from one or more foci of contagion, they merely show that a number of individuals had been exposed to the same local or general morbific cause; and that, while many were affected by it simultaneously, in some it produced the disease at an earlier, in others at a later period. That the disease has occurred sporadically, affecting only one member of a family, or a single individual of a community, is admitted by nearly all writers; but that it has ever been communicated directly from the sick to the well, we have not the slightest evidence. The above remarks are made in reference to simple angina gangrenosa: when the latter occurs in connexion with scarlatina, we admit that, in a certain sense, it is contagious.

Treatment. The treatment of angina will differ in some respects according to the particular form of the disease and the urgency of the symptoms. It will be considered at length in the separate articles devoted to the various inflammatory affections of the throat. A few general remarks are all that will be presented on the present occasion.

Angina is in all cases a disease extremely harassing and painful to the patient, and one which may, in many instances, either by its immediate or remote effects, result in the extinction of life. Its early and complete removal, therefore, is in every instance a point of very great importance. To effect this, we know of nothing that will so generally succeed as an emetic, administered, when nothing is present in the case to forbid its use, at the very onset of the disease, or during its early stage, before the inflammation and swelling of the throat have arrived to any considerable height. In a large number of cases, the progress of the inflammation may by this means be immediately and effectually arrested, more especially if the emetic be followed by a stimulating pediluvium and slightly astringent gargles.

After the disease is fully formed, leeches to the anterior parts of the throat, and, if the patient be robust and plethoric, bleeding from the arm, saline cathartics, mucilaginous drinks, and nauseating doses of emetic tartar, will in general be demanded.

When the larynx becomes the seat of inflammation, the safety of the patient will depend solely upon a prompt resort to the most energetic remedies. Here bleeding from the arm, and leeches to the throat, should be resorted to with the least possible delay, and to an extent proportionate with the violence and urgency of the symptoms. If the impediment to respiration be not by these means quickly removed, and it very seldom will be if effusion has taken place in the sub-mucous cellular tissue of the larynx, the resort, without delay, to laryngotomy, has been advised, and several cases have been published within a few years, in which the lives of the patients were evidently preserved by this operation; respiration having been thus kept up during the period requisite for the removal of the laryngeal affection, and when, in consequence of the extreme tumefaction of the mucous tissue, the glottis had been to all appearance completely closed.

In the pseudo-membranous and gangrenous forms of angina, the application of various remedies immediately to the parts affected has been strongly recommended by different physicians. The articles employed are the nitrate of silver, the nitric and hydrochloric acids, solutions of alum or of the sulphate of copper, infusion of capsicum, &c. By some practitioners, one or other of these is resorted to, from the very commencement of the disease, and is depended on almost to the exclusion of every other remedy; but in general the topical applications are employed in combination with general bleeding and leeching, the warm bath, revulsives, &c., or after the latter remedies have been carried as far as is thought advisable.

This is not the place to enter into an examination of the propriety of these topical applications, nor of the comparative efficacy of the different plans of treatment which have been proposed for the cure of angina in its various forms: for these, the reader is referred to the articles *Tonsillitis*, *Pharyngitis*, *Laryngitis*, *Croup*, *Scarlatina*, &c.

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V

ANGINA PECTORIS. *Cardiogmus cordis sinistri*, SAUVAGES; *Sternocardia syncoptica et palpitante*, SLUIS; *Syncope anginosa*, PARRY; *Sternocardia*, BRERA; *Sternalgia*, BAUME, HOSACK, and GOOD; *Asthma spastico-arthriticum inconstans*, STOELLER; *Diaphragmatic Gout*, BUTTER; *Asthma convulsivum*, ELSNER; *A. arthriticum*, SCHMIDT; *A. dolorificum*, DARWIN; *Asthenia pectoralis*, YOUNG; *Angor pectoris*, FRANK.

L'Angine de Poitrine, Fr.; *Brustbräune*, Germ.; *Angina di Petto*, Ital.

In 1768, a disease was described under this title (*angina pectoris*), by HEBERDEN, in the 2d volume of the Medical Transactions of London, then supposed to be a new one. Doubtless, it had pre-existed, and seems, indeed, to have been previously noticed, but so casually and imperfectly, as not to command attention.

Curiosity, on the appearance of the publication just mentioned, was directed to the disease, and though since carefully investigated, its pathology is still very obscure and undefined.

Symptoms. The disease is of a decidedly paroxysmal character. An attack of it, in most instances, according to our observation, is preceded by considerable derangement of the primæ viæ, presenting some of the phenomena of indigestion, as flatulence, sour eructations, cramps of the stomach, torpor of the bowels, and pains in the limbs. But it sometimes comes on without any, or a very slight premonition, usually, while the individual is walking or making some other exertion; in which case, he suddenly pauses, and endeavours to catch at something to support him, or slowly seats himself, as if apprehensive even of this effort. The face is pale, with a haggard expression; a cold sweat breaks out; there is a painful sense of constriction of the chest in the cardiac region, or at the sternum, extending to one or both arms, the left arm more commonly; at first no further than the insertion of the deltoid muscle, though successively it may reach the elbows, wrists, and sometimes even the extremities of the fingers. This, however, is a very mild paroxysm, which will often subside on the withdrawal of the ex-

citing cause. As appertaining to a more violent attack, it may be stated, that in addition to the pain in the chest and superior extremities, amounting in some cases to excruciating agony, having indeed been compared to the piercing of nails, or the laceration by the claws of animals; (LAENNEC)—there is extreme irritability of the stomach, anxiety, palpitations, or constrictory pain in the heart, a sense of suffocation, which is rather from tightness and fullness in the chest, than real difficulty of breathing, with many other affections, seemingly to denote the immediate extinction of life; and it has been remarked, that patients in this state of suffering almost always believe that they are actually dying. During this period the pulse is variously affected, sometimes little changed, on other occasions irregular or intermittent, often weak, and is described as being full, active, and bounding. Each of these states we have witnessed. The paroxysm is of very indefinite duration, from a few minutes to one or more hours, according to its severity, and still more the inveteracy of the disease—it proving, for the most part, lingering and severe, or the reverse, in proportion to the long or short standing of the case, though probably the average period is half an hour of unabated endurance. Equally does this hold in relation to the frequency of its recurrences, the interval in the commencement of the disease being distant, progressively less, till finally it is so much curtailed, that there is scarcely any exemption.

Great, however, as is the distress in the paroxysm, it seems not early to affect the constitution, nor to entail any permanent mischief. The individual often apparently enjoys good health in the intermissions, and performs all his functions naturally, and without embarrassment, till a short period before an attack. By a protracted continuance, however, the system begins to give way, which, as before stated, is announced by disorder of the chylopoietic viscera; and, with a group of dyspeptic symptoms, there are impeded respiration, pale and doughy countenance, soft flabby integuments, œdema of the lower extremities, and the other manifestations of cachexy. But such an issue is comparatively seldom, it more frequently happening, that in anticipation of these degenerations, the case abruptly ends during a paroxysm fatally.

It is said that the disease usually selects for its subjects the middle-aged, and men more than women, especially the robust and corpulent with short necks—of habits indolent and sedentary, and very often *the gouty* and rheumatic. But it is by no means confined to individuals of the former description. In several cases which have come under our own notice, the persons were quite otherwise—or slender, and of delicate constitutions. Nearly the same remark is made by a late writer. "Of the persons," says he, "who have come under my care, as many were of a spare as full habit. I have seen," continues he, "only one under the age of fifty, and only one woman who died of it." (JURINE.)

It is affirmed by FORBES, that of eighty-eight cases related by different authors, only eight, or one-eleventh of the whole, occurred in females; and of eighty-four, whose ages are recorded, twelve only were under fifty years of age.

The disease, as previously mentioned, is ordinarily excited by some motion, as walking, and, particularly, by ascending a flight of stairs, or a hill, or any other acclivity; and is more apt to be so, when the stomach is full. It may, however, be induced by the most trivial agencies, in very susceptible habits, as by sneezing, coughing, loud speaking, straining at stool, or by the indulgence of passion, or by other mental emotions, or perturbations, and has occurred in a state of absolute repose, the person being aroused from sleep by an attack.

Diagnosis. The case with which angina pectoris will be most apt to be confounded, is asthma. But it may generally be distinguished by a minute attention to the circumstances incident to the history of each affection. Thus the paroxysms of asthma come on usually at the close of the day, or in the night, continue much longer, are characterized by a heavy dyspnœa, with wheezing, &c. are relieved by exposure to fresh air, and subside gradually towards morning. Neither are they excited in the same way, nor by similar causes, nor marked by the position or acuteness of the pain in the sternum, arm, &c. or by several other distinctive and peculiar features. But where these diagnostics do not prove sufficient, an appeal should be made to the external means of exploration, percussion, and auscultation, and which will also clear up the obscurities as to other pulmonary and cardiac affections that have an analogy to angina pectoris.

Prognosis. In regard to the prognosis, it may be summarily stated, that, in cases of no inveteracy of character, cures may generally be effected. But where the case is fixed by time, and is attended by any organic lesion, or a decayed constitution, the result is the reverse, and death sooner or later inevitably takes place. It

is affirmed by FORBES, that of sixty-four cases, the event of which is recorded, forty-nine terminated mortally. Every fatal termination which we have witnessed, amounting to several instances, was as sudden as the electric shock—the movements of the heart seeming to be instantaneously arrested.

Morbid Phenomena. In several instances of the disease, not the slightest morbid appearances could be traced. But sometimes the heart has been found variously diseased, by the ossification of its valves, or those of the large vessels, or of the coronary arteries, or by depositions of adipose matter, so as to impede its functions, or by effusions into the pericardium, or by simple hypertrophy. Not the least common occurrence, perhaps, is a pale, flabby, softened state of the muscular structure of the heart, so much so, sometimes, as to be easily mashed between the finger, like wetted paper, or putrid meat. In the language of a late writer, "it is a fact, that there is scarcely any mal-conformation of the heart or its blood-vessels, that has not been occasionally found after death, from what would be considered angina pectoris; while, on the other hand, individuals have fallen victims to the affection, fully marked, and the most accurate post-mortem examination has not been able to detect the slightest indications of structural derangement." (UWIN's *Compendium of Theoretical and Practical Medicine.*) The morbid phenomena, in some instances, have been found in other parts, the heart being entirely exempt, as water in the pleural cavity, adhesions of the lungs, thickening and other changes of the mucous membrane of these organs, dilatation of the bronchi, œdema of the cellular tissue, an abscess of the mediastinum, scirrhosity of the pylorus of the stomach, and enlargement of the liver, ossification of the cartilages of the ribs, &c.

Pathology. As already intimated, our knowledge of the pathology of the disease, is not at all precise, or satisfactory. This may, in part, be owing to the great diversity of phenomena exhibited in post mortem examinations, which have served rather to perplex, than to guide our speculations. No doubt, many of these lesions had no immediate connexion with the disease, either as cause or effect; and, perhaps, exercised little influence over it. There are others, however, which, though not concerned in occasioning it, may be deemed its products, or consequences, where the case is chronic, and has preyed, as it were, on the constitution. Nor is it improbable, that, from the novelty of the disease, it has not always been well understood, and some analogous affections, of which there are several, have been mistaken for it. Before these reports, therefore, can be fully accredited, we ought to have a minute and faithful history of the cases to which they relate, and these subjected to a careful scrutiny. Let the facts be thus ascertained, and we shall then move on in our pathological enquiries, with some certainty of success. By several writers on the subject, the disease is held to be spasmodic, though the part immediately implicated, seems not to have been designated, or understood. This hypothesis is rendered probable, by the general complexion of the case—its causes, symptoms, and cure, and by its resemblance to the diseases confessed to be of that character. Entertaining such a conviction, it is called by DARWIN, *Asthma dolorificum;* and by ELSNER, *Asthma convulsivum.* By BUTTER, it is referred to a spasm of the diaphragm and other muscles of respiration; and by SCHÆFFER, to an incomplete paralysis of the heart, and a periodical spasm of the pulmonary vessels. It has been ascribed, by ROUGNON and BAUMES, to ossification of the cartilages of the ribs, preventive of the expansion of the chest necessary when the circulation is accelerated, and which determines a stagnation of blood in the heart; by HAYGARTH, to an abscess of the mediastinum. BRERA, PORTAL, LATHAM, ZECHINELLI, and AVERARDI, suppose it to be owing to displacement and compression of the heart, from tumefaction of some organ of the abdomen; and FOTHERGILL believed it to be occasioned by obesity, and particularly by a collection of fat in the chest, and sometimes, as he thinks, it may be symptomatic of water in this cavity, or in the pericardium.

It has been attempted to be shown, by PARRY, that it is a species of syncope, denominated by him, syncope anginosa, caused by an accumulation of blood in the heart, from an ossification of the coronary vessels; in which view he is supported by JENNER, BOSTOCK, BURNS, KREYSIG, and many other authoritative writers.

To this opinion, it may, in general, be objected, that there is no evident connexion between the effect and the cause. That an ossification of these vessels may be productive of great disturbance in the animal economy, is exceedingly probable, though such is not uniformly the result, without however affording reason to believe, that the peculiar agony and distress of angina pectoris, would be the consequence. The cause being permanent, the disease too should continue at all times, with little or

no abatement. But so far from this happening, we are told by all the writers, in which our own observations coincide, that there is often very good health in the intervals of the paroxysms; nor dependent on such a lesion, should it be curable. Even PARRY, however, admits that one case was cured by the Bath waters; and we shall hereafter see that recoveries frequently take place.

Completely, however, to confute this notion, it is only necessary to mention, that in several instances of the disease, which terminated fatally, no such morbid appearances could be discerned about the heart. LAENNEC expressly tells us, that he has examined several subjects who had laboured under the disease, and in none of them did he find the coronaries ossified. But RECAMIER goes further, and declares, that he never witnessed it in any instance of all those which he had inspected. (*Med. Chirurg. Rev.* N. S. X. 573.—1829.) Even where the alleged ossifications existed, the complaint sometimes was very obscurely and indistinctly marked. Cases, indeed, are recorded, by MORGAGNI, SENAC, WATSON (*Med. Com.* I. 234.), and CORVISART, in which ossifications had no effect whatever of this kind. The same thing has been remarked by SHAW, in his Manual of Anatomy, who says, that in many old people, never having had the slightest symptom of the disease, he has "found the coronary arteries like tubes of bone, through their whole course." COOKE, in his treatise on the digestive organs, confirms this report. Numerous instances of this lesion of those vessels, he says he has met with, without a symptom of the disease.

By a distinguished writer of our own country, Dr. HOSACK, it is conjectured, that the disease proceeds from a "plethora of the blood-vessels, more especially from a disproportionate accumulation in the heart and larger vessels." Considering this to be scarcely better founded than the preceding hypothesis, we shall not enter into any detailed examination of the arguments or facts by which it is endeavoured to be sustained. It may be sufficient for our present purpose, merely to observe, that, even allowing the fullness and irregularities in the circulation contended for, as the basis of the hypothesis, which we are by no means disposed to do, as uniform concomitants, these we should take to be rather the effects of previous irritation or excitement, than the cause of the disease. Do we not also know, that such a condition of the vessels can exist without inducing angina pectoris? Were fullness and irregularity in the circulation only required, for the production of the disease, instead of a rare, would we not have it as a daily occurrence? The fact, moreover, is, that angina pectoris, though oftener, perhaps, attacking the plethoric, is to be met with, as before said, in the feeble and attenuated.

Taking everything into view, JURINE is led to consider the disease as a nervous affection, which opinion he supports by a long train of reasoning. Comprised in a few words, his arguments are deduced from the unexpectedness of the attack, its suddenness of termination in death or restoration to health, the nature of the exciting causes of a paroxysm, the equality and regularity of the pulse, the peculiarity of the respiration, the painful sensation extending to the upper extremities, and finally, the method of cure, by antispasmodics, &c.

The proximate cause, says he, is connected with an affection of the pulmonary nerves, which disturbs the function of the lungs, impairs the decarbonization of the blood, and produces, previously to an attack, the pain in the sternum. This morbid affection of the pulmonary nerves, must in time be communicated to the cardiac plexus, and affect the heart and vessels secondarily. The imperfect decarbonization of the blood, lessens its stimulating powers on the heart and lungs, gives rise to reiterated attacks, until this stimulus being exhausted, occasions the death of those organs, and then of the brain.

LAENNEC has adopted the same view of its nervous pathology, with this difference, that he considers the seat of the affection may vary according to circumstances. Thus, he states, that when there exists simultaneously, pain in the heart and lungs, we may presume that the affection is principally seated in the pneumogastric; and on the contrary, where there is simply stricture of the heart, without pulmonary pain, or difficulty of breathing, its site is in the nervous filaments, which the heart receives from the great sympathetic. But other nerves may also at the same time be implicated, either by sympathy or from direct anastomosis, and the branches of the bronchial plexus, particularly the cubital, are nearly always so. The anterior thoracic originating in the superficial cervical plexus are, moreover, frequently affected, and this is sometimes further the case with the branches derived from the lumbar and sacral plexes, when the thigh and leg participate in the attack, which occasionally happens.

That the disease is a species of neuralgia, we are entirely persuaded, commencing

for the most part in the pneumogastric nerve, and spreading in different directions, as other nerves may become involved. The derangement of the heart and other structures, with which it is sometimes associated, we hold to be coincidences or effects, and not the cause, since, among many reasons which might be adduced in corroboration of this, the disease has undoubtedly prevailed independently of such organic lesions, and conversely these have existed, without occasioning it. But, what is the immediate cause of that irritation of the nerves, inducing the neuralgic condition, giving rise to the subsequent phenomena of the disease? This is a question, which hitherto has not been clearly answered. That it is in many instances, at least, derived from irregular gout, which misplaced, thus operates as an irritant to the nerves, and probably first of those of the stomach, seems highly probable.

In support of this view of the pathology of angina pectoris, it may be remarked, that mostly the subjects of the disease are of the period of life, the constitution and habits liable to irregular arthritic affections, which are well known to be Protean in their character, exhibiting every diversity of shape and aspect, and particularly of asthma: that in nearly all cases, an attack is preceded or attended by more or less derangement of the alimentary canal, manifested by flatulence, sour eructations, cramps, and costiveness: that the pain goes off reversely from that in which it comes on, subsiding first at the extreme point, and the paroxysm closes with belchings, &c.: that, in the intervals of the attacks, the individual enjoys for the most part good health, till, by long continuance, the constitution becomes shattered. These are particulars in which it very closely resembles atonic or misplaced gout; and it may be added, in confirmation of the stomach being the seat of the disease, that the disturbance in the functions of the lungs, or of the heart, invariably presents more the appearance of secondary than of primary affections.

The phenomena sometimes revealed by post-mortem examinations, do not in the slightest degree invalidate this hypothesis. They are, indeed, very much such as might be expected in structures, long exposed to the disorganizing influence of gout, and which have actually occurred, where there was no doubt of the existence of that very disease.

What, however, completely establishes our faith in the occasional arthritic nature of angina pectoris, is, the history of several supposed cases of that disease, which, after a long continuance with the ordinary symptoms, and treated accordingly, terminated in unequivocal gout.

Case I.—The first of these cases was that of a distinguished member of the bar, aged fifty-seven years, of slender form and temperate habits, to whom we were called in the night, during the winter of 1811. The moment we entered his chamber, we recognized all that sort of distress which characterizes this disease. He told us, that he had for several years previously, been subject to attacks of angina pectoris, for which he had been treated by Dr. Kuhn and Dr. Wistar. His pulse being active, with great agony in the region of the heart, he was bled copiously, and suspecting gout, though we were assured he was not liable to it, sinapisms were applied to the feet, and the carbonate of ammonia, with wine whey, freely administered. In the course of a few hours, arthritic swelling seized on the knee joint, with the occurrence of which all other uneasiness instantly subsided. By such a course of management, as will hereafter be detailed, he recovered his health, never having afterwards an attack either of angina pectoris or gout.

Case II.—In the spring of the same year, we were requested to visit a lady in the country, of middle age, great corpulency, and of indolent or sluggish habits. The account which she gave us, was, that for a considerable period she had suffered extremely from various thoracic uneasiness, which had been pronounced by the same distinguished physicians to be angina pectoris, and treated accordingly. The attacks she told us were then so readily excited, even by the slightest exertion, that she was compelled to remain almost stationary in her room. Learning that both of her parents, and particularly the mother, were gouty, though she had hitherto escaped, we thought it advisable to venture on a practice dictated by the supposition of its existence in her case, and accordingly, after the loss of a pint of blood, directed that her feet should be immersed morning and evening in a warm mustard bath, and thoroughly rubbed, to take the carbonate of ammonia, and to use moderately sherry wine. Not deriving any essential benefit from this treatment, she came to the city, and on the very afternoon of her arrival, we saw her in a violent attack of the disease. Cupping was ordered between the shoulders, and over the cardiac region, and a pair of blisters to the ankles, after a stimulating pediluvium. During the night she had a paroxysm of podagra, which completely relieved the embarrassment of the chest,

and from that time, till 1830, when she died of dysentery, she had no return of the anginose affection, though annually more or less of regular gout.

Case III.—In March, 1813, we met Dr. James Rush in consultation in the case of a middle-aged gentleman, of robust make, and plethoric condition, who for several hours had laboured under a paroxysm of angina pectoris, to which disease he had been a martyr for many years. With his case we were familiar, having often attended him before, as the pupil of the late Professor Rush. His sufferings, at the moment of our visit, were very distressing. Having been bled previously, to which he always resorted on an attack, we ordered the carbonate of ammonia, wine whey, and sinapisms to the lower extremities. To our great satisfaction we found him, on our return after breakfast, entirely relieved by a fit of podagra, which had taken place in our absence. With orders to continue the remedies till our next visit, we left him. But deeming himself well, these were omitted, and he arose from his bed, and seated himself by the fire, thinly clothed, especially as regarded the feet. In this position, while engaged in cheerful conversation with a friend, he suddenly exclaimed, that the gout had quitted his foot, and seized on his heart, and in a moment expired.

Case IV.—In the spring of 1824, we were requested by Dr. Physick, to visit with him a gentleman from the country, aged about fifty years, who informed us, that for several years he had been sorely afflicted by a complaint, considered by all the physicians whom he had consulted as angina pectoris. The history given us of the case, embraced most of the prominent symptoms of that affection. Attacks of it he told us were of very frequent occurrence, and brought on by the slightest causes, from one of which he was then suffering partially.

As the ordinary practice had utterly failed, we determined to treat the case as irregular misplaced gout, and with a view of drawing it to the extremities, employed the customary revellents with carbonate of ammonia and wine whey. On the third day of our attendance, the gout became fully fixed in the elbow joint, and in every other respect he felt perfectly well. Most unhappily, however, having omitted the remedies during the night, he arose in the morning to be shaved, and while the barber was occupied in that office, he insisted on performing it himself, as he had regained the use of his arm, from the cessation of the arthritic swelling. But scarcely was the razor in his hand, when he complained of sickness of stomach, with excruciating pain in the left side, and sunk lifeless on the floor.

Case V.—In the autumn of 1824, we were consulted by a gentleman of Baltimore, who had previously been under the care of some highly respectable physicians for this disease. He was then in the meridian of life, of originally vigorous constitution, somewhat impaired by a generous mode of living. He told us that he had constantly dyspepsia, and occasionally after a full meal, or when walking quickly, was seized with violent pain in the chest, extending down the left arm, and with excessive embarrassment of respiration. The idea of gout he discarded, as belonging neither to himself nor immediate progenitors, but was willing that the case should be so treated, and with written directions to this effect he returned home. Three years afterwards, he called to assure us, that his health had been perfectly restored by an attack of gout, which came on some months after having formerly seen us.

Case VI.—During the summer of 1830, we were consulted by a lady of Louisiana, who transmitted to us a full statement of her case by her medical adviser, which was so strongly characterized as to leave no doubt of its being angina pectoris, and such it was viewed by him. Though there was little reason to suspect either hereditary or acquired gout, we suggested, on the authority of the preceding cases, that it should be managed under this impression of it, and we had the pleasure to learn subsequently, that having had an arthritic attack in the wrist, she recovered.

It were easy from our own experience to supply further illustrations of the correctness of the hypothesis which we are endeavouring to support. But we have afforded the most striking instances, and to proceed with recitals of this kind, might be tedious.

It was once our conviction, that this pathological view was original with us. But we have discovered that Butter, in a small treatise on the subject, entertains nearly the same notion, and hence denominates the complaint, "*Diaphragmatic Gout.*" Even he, we have also ascertained, has been anticipated by Elsner and Schmidt, the latter of whom, in conformity to his particular notion of its nature, entitles it, "Asthma Arthriticum."

The preceding review abundantly confirms the remark, which we made, on the imperfection of our knowledge of the pathology of angina pectoris. It may be deduced from it, that we are in possession of

little else than mere hypotheses, each one having formed his own, on no other foundation than the facts supplied by a few cases or dissections. These varying considerably, a complexional hue has accordingly been given by them to the opinions of those by whom they were respectively observed.

Treatment. The treatment of this disease is necessarily divided into what is proper during the paroxysm, and in the interval, in reference to a radical cure. As soon as possible, the patient is to be placed in a state of rest and tranquillity. Next, where the symptoms are urgent, and the pulse tolerably vigorous, we are to use venesection; and to prove effectual, the quantity of blood detracted must be large. Ten, fifteen, or twenty ounces, are to be taken at once; and we may sometimes find, in the more violent cases, a necessity for repeating the operation in the course of a very short time. The fact is, that the case may be of such a nature as to admit of no delay, and, as in some similar emergencies, a feeble and timid practice is inevitably fatal. It is therefore a good rule to urge the lancet till relief is afforded, or as far as we can consistently with safety. But should this general depletion be forbidden, or prove ineffectual, cups or leeches may be applied with great utility to the back or cardiac region, and a blister to the breast. The bowels are then to be opened freely with some prompt purgative.

That the course we have recommended, differs very widely from that indicated by most of the European writers, cannot escape observation. Considering the complaint as spasmodic, they resort pretty much to the class of means, the best suited, in their estimation, to overcome this form of diseased action; such as opium, ether, musk, camphor, assafetida, oil of amber, hyosciamus, belladonna, &c.

No doubt, either in the incipient stage of the paroxysm, if it be mild, or when it is in a measure subdued by depletion, this treatment will very often answer well. It is precisely what we would do under such circumstances, and have done, with the greatest advantage. Given at the very commencement of an attack, a dose of laudanum, or ether, may afford relief; and either of these articles, or the musk julep, is not less effectual after depletion. The point for which we contend is, that the paroxysm being completely formed, and of a vehement character, attended by severe cardiac spasm or engorgement, can only be subdued, or at least, that it is more speedily and effectually subdued, by venesection and its auxiliary evacuations, than by any other means. Yet, where the strength of the patient is greatly depressed, we must resort to venesection with circumspection, lest in such state the system should not react, and we might produce irreparable mischief.

Emetics were, at one time, recommended in the paroxysm, and there is some evidence to their efficacy. But on a more extensive trial, they were found, though occasionally useful, often injurious, and we are inclined to believe, are now abandoned.

To invite the disease to the extremities, is an indication never to be lost sight of at this period, to effect which, stimulating pediluvia and sinapisms, or blisters, with all the other measures employed under similar circumstances in irregular or misplaced gout, are here applicable. By this course, we have sometimes succeeded in affording speedy relief.

This brings us to the consideration of the remedies to be directed in the interval of the paroxysm. Examining, however, what has been done in this part of the treatment of the disease, it will be seen that it has been conducted on no enlightened principle. Though its pathology be still dark, we may at least determine, in most instances, the cause of it, and the condition of system with which it is associated. As in every other case, these constitute the main foundation of successful practice. Considering the disease as mostly of an anthritic nature, we have been very much influenced in our management of it, by such a view. Being of recent origin, and, of course, independent of any structural lesion, we treat it, in every respect, as we would misplaced gout, more unequivocally marked, in the same position. Our plan, in a word, is, impressively to inculcate the importance of studiously avoiding all the exciting causes of a paroxysm. To this end, the diet must be light and digestible, the bowels be so regulated as to obviate constipation, and exercise in a carriage, or on horseback, be moderately used. Let it be recollected, that in some of these cases, when the slightest movement on foot brings on an attack, or proves highly distressing, any degree of exercise may be taken in the modes just indicated. In the case attended by Dr. Physick and myself, which was formerly mentioned, this was remarkably exemplified. We were told by the individual, who was a lawyer, that though he could not walk a short distance between his office and the court-house, without bringing on a paroxysm, he could go thither and plead a cause, provided he was transported on a horse or

by any vehicle, and had even performed long journeys comfortably, by such conveyances. The remedies are topical and general, and with the former we shall commence. Every practitioner confesses the importance of establishing some counter-irritation or drain in this disease. It was formerly the custom to accomplish this by a perpetual blister to the chest, but of late the peculiar irritation from the emetic tartar plaster or ointment, seems to be preferred, and is now very generally substituted.

Yet, scarcely less is said of the efficacy of issues introduced into the inside of the thighs, by which alone there are recorded not fewer than eight or ten cures, proceeding too from such authorities as Macbride, Darwin, &c. &c. As encouragement to this practice, it is stated by Blackall, that one of his patients, who had never for a single week been free from the disease for ten years together, lost every vestige of it for the last nine months of his life, during which he suffered from ulcers of his legs.

By Laennec a remedy has been very confidently proposed, with which having no experience, we merely mention on his authority. It is the magnet, used in the following manner. He applies two strongly magnetized steel plates of a line in thickness, of an oval shape, and bent so as to fit the part, one to the præcordial region, and the other exactly opposite on the back, in such a manner that the magnetic current shall traverse the seat of the affection. Without claiming infallibility for this remedy, he avers, that it has succeeded better in his hands than any other, as well in relieving the paroxysm, as preventing its return.

The general treatment usually consists chiefly of those tonics and nervines which are so much relied on in all the nervous or spasmodic affections. The bark and valerian had at one time a high reputation; and Jolly highly extols the sulphate of quinia, combined with opium and ether; but none of these, or any other of the vegetable tonics, are now much used. More confidence is placed in the mineral articles, and especially in the preparations of copper, zinc, and the nitrate of silver. Cures are reported to have been performed by each of these medicines—two very remarkable cases illustrative of the remedial powers of the last named article are recorded by Dr. Cappe. (*Lond. Med. and Phys. Journ.* IV. 221.) Efficacious, however, as these may prove, they are, we think, decidedly inferior to the martial preparations.

Arsenic, in the form of Fowler's solution, has been recommended by Dr. Alexander (*Med. Comment.* XV. 373.); and subsequently by Sir G. Blane, who gave it with advantage, combined with digitalis and mercury. (*Med. Chirurg. Trans.* IV. 136.).

Where there is a strong propensity to spasm, the articles formerly mentioned may probably be called in, with advantage, though hitherto we have met with no case in which they were required. The chylopoietic viscera being deranged, attended by vitiation of the secretions, an alterative course of mercury should be instituted, and the case proceeding from derivative irritations of other organs, the precise pathological condition of these, must be ascertained and removed by the appropriate means.

As preventive of an attack, where such is strongly manifested, plethora should be guarded against, by venesection, or purging, or by reduction in the mode of living, adopting the lightest possible articles of food. In those cases where the paroxysm is apt to occur at night, an opiate at bedtime is recommended by Heberden, and from which we have seen very decided advantage. It is in this way, that we have managed angina pectoris, and with such success, that we cannot help recommending it, with some confidence, to imitation.

Whether the cases which we have met with, were the genuine disease, we will not positively say. Certain it is, however, that they were marked by the ordinary symptoms, and most of them considered as such, by the highest medical authority, who concurred with us. Yet, we are not to expect uniformly to cure this disease. Cases of it, inveterately fixed by time, are commonly attended by some organic lesion, and when this happens, they will prove wholly intractable, to any, and every form of practice. N. Chapman.

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END OF THE FIRST VOLUME.